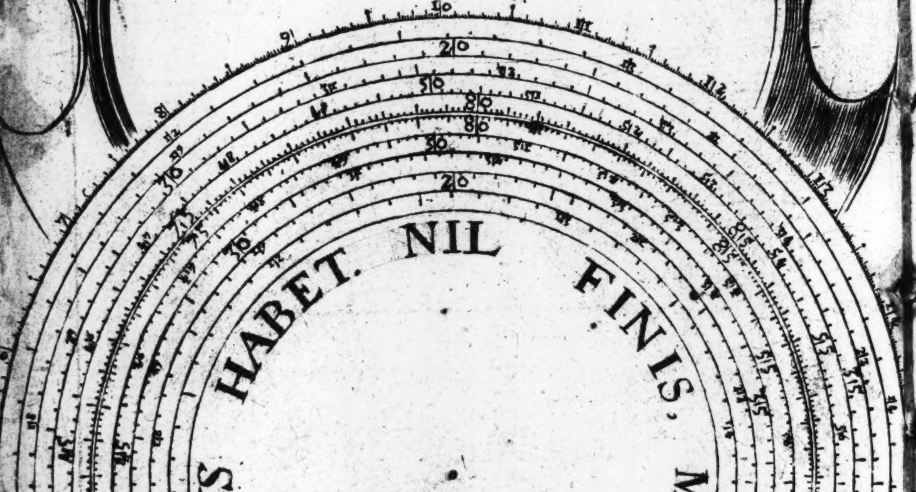
MIRIFICA
Logaritemorū Projectio Circularis



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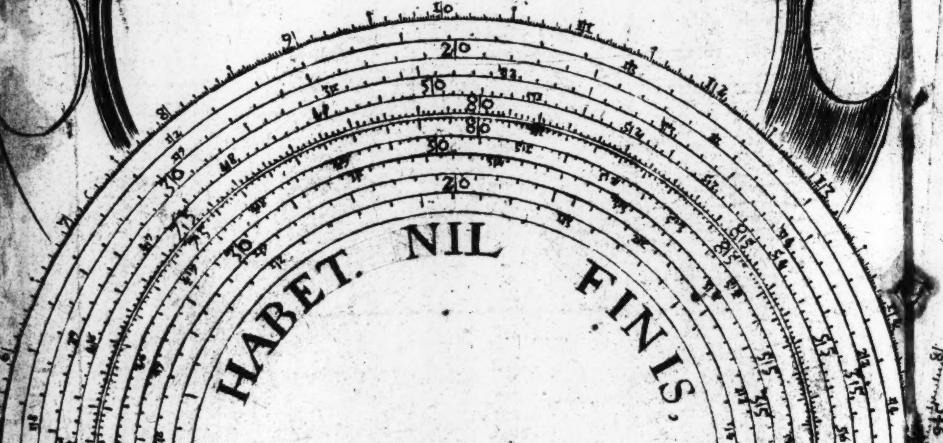


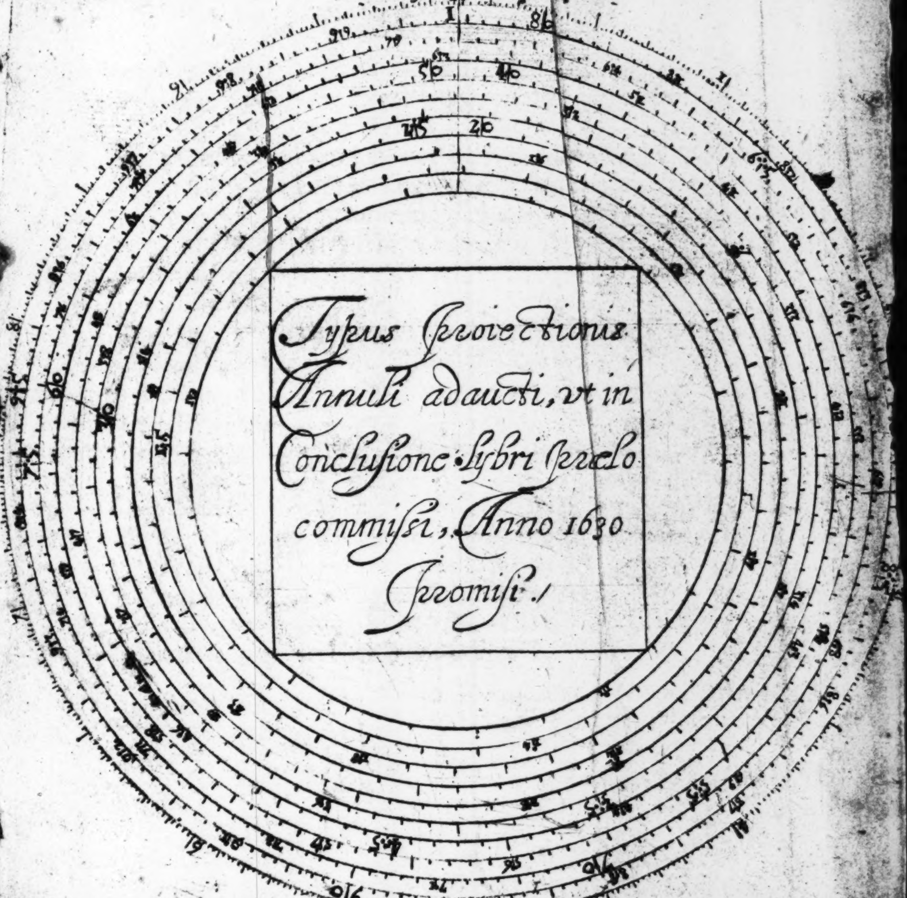
GRAMMELOGIA
Or, the Mathematicall Ring.

Extracted from the *Logarythmes*, and projected Circular: Now publiſhed in th
inlargement thereof unto any magnitude fit for uſe: ſhewing any reaſonable capacity that hath not *Arithmeticke*, how to reſolve and worke, all ordinary operations of *Arithmeticke:*

And thoſe that are moſt difficult with greateſt facilitie, the extraction of *Rootes*, the valuation of *Leaſes*, &c. the meaſuring of *Plaines* and *Solids*, with the reſolution of *Plaine* and *Sphericall Triangles* applied to the Practicall parts of *Geometrie, Horologographie, Geographie, Fortification, Navigation, Aſtronomie, &c.*

And that onely by an ocular inſpection, and a Circular motion, Invented an
firſt publiſhed, by *R. Delamain*, Teacher, and Student of the *Mathematicks.*

Naturæ ſecreta tempus aperit.



Typus Proiectionis
Annuli adaucti, vt in
Conclusione libri prælo
commissi, Anno 1630
Promisi.

To the High and Mighty King, CHARLES King of Great Britaine.

Dread Soveraigne,

HAd not your gracious favour given *life* unto my firſt *birth*, I ſhould not have dar'd thus boldly to ruſh into your *ſacred preſence*, but onely in humble confidence I am incouraged, that, as your *gracious Majeſtie* pleaſed to accept of my imperfect endevours, the ſame *bleſſed eye* will not now reject that *worke* brought to its fuller growth and perfection. *It* was the great *invention* of that *Noble Lo. Nepeir Baron of Marcheſton* his ever-worthily admired diſcovery of the *Logarythmes* in cutting off the toyleſome working by *Sines, Tangents, Secants, &c.* My paines formerly was converſant about to bring them likewiſe into a ſhorter way for *practicall uſes*, by an *inſtrumentall Projection* of theſe numbers in *Circles*, of which I compoſed my *Mathematicall Ring*. Every thing hath his beginning, and curious *Arts* ſeldome come to the height at the firſt; It was my promiſe then to inlarge the *invention* by a way of *decuplating the Circles*, which I now preſent unto your *ſacred Majeſtie* as the *quinteſſence* and *excellencie* thereof, whereby *Mathematicall operations* which tend to ordinary and uſuall *affaires* and ſuch of a higher nature, are performed accuratly, without tedious *extraction of Roots*, operating by naturall *Sines, Tangents, ſecants*, or the *Tables of Logarythmes* themſelves, and that by an inſpection of the *eye* alone and a *Circular motion*. It is now againe your *gracious acceptance* and the *publicke good*, which my life & paines are ſtudious of: the one I hope will acknowledge, the other defend theſe mine *honeſt labours* which ſome endevour to *rob* me of. I have no better thing as yet to expreſſe a *loyall ſubjects* heart, and affections by: but onely my *ſelfe*, which with my poore *endeavours* in all humble ſubmiſſion I caſt downe at your *ſacred feete*, accounting it my cheefeſt Happineſſe to be

Your Majeſties moſt humble, true,
and Loyall Subject,

Rich. Delamain

By a Friend upon the Mathematicall Ring.

VV*ithin a little* Circle, *or a round*
Of old, the double-ſix-ſign'd courſe was found,
And much it was, the whole yeares *toyle to bring*
Within ſo little compaſſe as a Ring.
Yet here enclos'd not one yeares *worke you ſee,*
But what without it ſcarce is done in three.

The ſame to the inventer of the Logarythmes projected in Circles.

None e're in Circles *found an* End *they ſay,*
Or ſaw Beginning *where abouts it lay:*
How was there then by thee beginning found,
Of that which in it ſelfe is perfect round?
And yet (onely to prove the ſaying true)
Some doe deny it was found out by you:
So will have no beginning; If their owne,
The ancient Axiome *ſtill is overthrowne;*
But if it were not thine, how durſt thou ſay
Thou wouldſt augment the ſame another day?
Which day is come, and now that's decuplate,
Which ſingle *was before. Thus tis thy* Fate,
Still to encreaſe *thine* error, *and of one*
Make ten, *to ſhew thy good Invention:*
Looke to't, if one has bred ſo much adoe,
Tis ten to one, this will bee challeng'd too.
Well, guiltie be thou firſt of this lawes breach,
And for thy fault this cenſure ſhall thee teach,
That though Beginning *thou to this didſt lend,*
Yet of it's copious uſe thou's ne're find End.

By a Lover, and Student in the Mathematicall Arts.

THriſe noble Nepier *by his learned ſtraine,*
Invented profound numbers with great paine,
From whence rare proiections doe ariſe,
That praiſe their Author *who did them deviſe,*
Which now againe, anew this Inſtrument
Doth thoſe his numbers *quickly repreſent.*
And as the Orbes *by motion alwayes ſhew*
Divers apparences which ſtill are new,
So infinit performances thereby
Are pointed alſo out unto the eye,
In multiplication, diviſion, *and*
Beſide it makes you how to underſtand,
To finde out meane proportionalls, *that ſo,*
You may by ſight of it proportions know.
Beſides all this, which is a thing more high,
It helpes to worke in Trigonometry,
Scorning Roots *extracting, by partition,*
Or graduall numbers circuition:
It equates *regular* figures; *and doth ſhow*
The ſolid bodies *and the* plaines *alſo;*
Giving their ſides, and perfect ſymmetrie,
And ſpeedily their true ſoliditie,
Their circuits, *and* ſpheares *will all appeare,*
Both circumſcribed *and* inſcribed *here;*
Their Diameters *and* tranſmutations,
In duplications *and* triplications.
And as the Logarythmes *did at firſt exceede,*
In their Inventions, *all that did proceede,*
Or were before in any former age,
So that which now this Author *doth inlarge,*
Amongſt theſe numbers is a worke of grace,
By expeditious uſe for future race,
In waightie things much to delight his mind,
Who ſtudious is the practike *way to finde,*
If after ages ſeekes by Inſtrument *to know,*
With greater eaſe makes eaſe exceſſive grow.

In

In mirificam Logarythmorum projectionem Circularem.

NEperum meritò totus mirabitur Orbis,
Qui Logarythmiacos repperit arte modos:
Radicem extractam dempſit, Tangenſq́; ſecanſq́;,
Atque ſinus, duram difficilemq́; viam:
Ritè Mathematicam & ſubitò cognoſcere praxin,
Si quis amat, præſtant Organa rara nova:
Rara Logarythmi projectio, circulus iſq́;
Mobilis aſpectu, hæc ardua cuncta docet.
Hîc *tibi cernuntur proportio recta, triumq́;*
Regula, diviſi & multiplicantis opus:
Hîc *tibi radicum eſt extractio tracta figuris,*
Corporis hîc plani, ſic ſolidiq́; metron:
Analyſis *plani tibi ſphæratiq́; trianglî,*
Cernitur, hîc praxis quamq́; matheſis habet;
Et latet hîc uſus quem non natura recluſit,
Illum mirificè aſt Organa adaucta docent.

To the courteous and benevolent Reader that affects this inſtrumentall practiſe of the Logarythmes projected circular Intituled Grammelogia, *or the* Mathematicall Ring.

AS that Honorable Lord *Nepeir* (the firſt inventer of *Logarythmes*) did call his *Rods* by reaſon of their facility in operation *Rabdologia*, the ſpeech of *Rods*, and his numbers, *Logarythmes*, the ſpeech of *numbers*: So this *Inſtrumentall Projection* as ſpringing from that invention, I called *Grammelogia*, the ſpeech of *lines*; for being ſo projected as they are, theſe lines graduated, doe promptly teach one what to ſpeake in *proportionall operations*; which invention of projection of *Logarythmes Circular*, I promiſed to enlarge at the end of my firſt publication, with this intituled *Grammelogia*, or the *Mathematicall Ring*, Printed, Anno. 1630. notwithſtanding it was there ſufficiently perſpicuous, how it might bee augmented unto any magnitude aſſigned, even to operate unto *minuts*, and *ſeconds* in *Trigonometrie*, and to finde *Rootes*, and *proportionall numbers* in common *Arithmeticke* unto ſixe or more places: a *diagramme* of which projection I now here deliver, as fully ſufficient to ſhadow out to the more learned the quinteſſence of this *Legarythmall projection* in *Circles* unto 6. 10. 40. 100. or 1000. yea, to as great a capacity as one deſires, (a project by Inſtrument never yet produced, though long deſired) which plurality of *Circles* in this projection, muſt be conceived to bee the parts of *Circles*, and ſo there may bee a *quadruplicitie* of them, one of which *Quadraplicities*, may containe the *Logarythmes of numbers*; another may comprehend the *Logarythmes of ſines*; and the other two may bee for the inſerting of the *Logarythmes of Tangents*: ſo in this Scheme here delivered noted with the letter *B*. there are 16. *Circles* in view, but 4. in effect, each of which 4. muſt be conceived to be broken into parts as before: in the firſt of which *Quadruplicitie of Circles*, there are graduated the *Logarythmes of numbers*, (as before) from 1. unto 100000. noted with the letter *N*. and ſo may bee properly called the *Circle of numbers*: in the next *quadruplicitie of Circles* there are graduated the *Logarythmes* of *ſines*, from 34.m.22.ſe. unto 90.gr. noted with the lettet *S*. containing two revolutions, that is, two perfect *Circles*, & therefore is divided & figured double, beginning his firſt revolution at 34.m.22.ſe. and ending at 5.gr.44.m.21.ſe. which are graduated upon the inner edge of the *Circle*: the ſecond revolution begins at 5 gr.45.m.21.ſe. and ends at 90.gr. which are graduated and figured on the outward edge of the *Circle*, which graduations and diviſions of *ſines*, may be therefore called the *Circle of ſines*. Laſtly, the next two *quadruplicities* of *Circles* which are noted with the letters *T.T*. do containe foure *revolutions* or *Circles*, becauſe alſo of their double diviſions, in which are inſerted the *Logarythmes of Tangents*, from 34.m.22.ſe. unto 89.gr.25.m.38.ſe. beginning the firſt *revolution* at 34.m.22.ſe. and ending at 5.gr.42.m.38 ſe. which are divided and figured upon the outer edge of the *Circle*; the ſecond revolution begins at 5.gr.42.m.38.ſe. and ends at 45.gr. and are graduated and figured alſo upon the outerſide of the *Circle*. The third *revolution* begins at 45.gr. and ends at 84.gr.17.m.21.ſe. and are graduated and figured upon the innerſide of the *Circle*. Laſtly, the fourth *revolution* begins at 84.gr.17.m.21.ſe. and ends at 89.gr.25.m.38.ſe. all which graduations of *Tangents* may be called in like manner the *Circle of Tangents*. And as that famous of memory (if not moſt injuriouſly late made infamous) and worthy *Mathematician*, Mr. *Gunter*, the firſt that gave light to this Invention, did call his lines the lines of *Numbers, Sines*, and *Tangents*, or the *lines of proportions*; ſo this whole projection as adherent unto it, may not unfitly be called the *Circles of Numbers, Sines, and Tangents*, or in reſpect of operation (as ſome others lately called the *Circles* of my *Ring* ſingly projected on a *Plate* or *plaine*) the *Circles of proportion*, in which may be noted, that if this projection be made of 10. *Circles*, then may there be a *quadruplicitie* of them, which in all make 40. *Circles*, one *quadruplicitie* of which may ſerve for the inſerting the *Logarythmes* *of numbers,* another for the *Logarythmes of Sines,* and the other two for the *Logarythmes of Tangents.* If the projection be of 50. *Circles,* then the whole projection will be of 200. *Circles,* whoſe graduations, beginnings, and terminations in each whole *revolution* is the ſame with the former; and as there is a conformity in the *Projection* by a greater number of *Circles,* as there is by a leſſer; ſo is there the ſame facilitie and agreement in operation by many *Circles,* as by few, and the way how I have delivered in this Tractate, which is either by motion in a double projection, or in a ſingle projection, by helpe of a thred & lead, or a ſingle or double Index at the Center, or peripheria; upon which I deliver ſeverall wayes in this following Treatiſe. How it may pleaſe ſome mens affections I know not, my intentions and deſires are free. Now ſince the publication of the firſt kinde of *Logarythmes* Projection, Anno 1630. or the originall of this enlarged, it hath pleaſed many about this City and *Kingdome* to take liking thereunto, ſome contenting themſelves with the double projection, with a moveable and fixed Circle, ſome with the ſingle having an *Index* at the *Center*: but generally the moſt part have beene by ſome invited if not forced to that which carries, as they ſay, with it the aplauſe and vote of men by a comparative attribution delivered by the aſſumed *Author* of that with an Index on a *Plate,* that the way on the plate in a ſingle Projection with an Index at the *Center,* is a better way than that of my *Ring,* or that of a double *Projection* on a *Plaine*: The authority of whoſe words to ſome ignorant mechanick compoſors of that *Inſtrument,* was a ſufficient motive ever ſince to crowne his words with a divulged rumour out of their borrowed knowledge to maintaine his aſſertion, to put off their commodities, howſoever if the ſaddle (as the proverbe is) were put on his right place, this vote and attribution belongs to another, who fitted the *Inſtrument* ſo as it is now uſed, & yet modeſtly would not appeare in it, and not our ſuppoſed *Author,* which aſſumption of fitting of it ſo with an *Index* on a *Plate,* had beene enough if not too much, without ſuch a divulgation of endeavouring what in him lyeth, and in others, to annihilate and beate downe the way which I write upon, and to glory in the raiſing up of his ſuppoſed owne: thereby not onely poſſeſſing men with an untruth, but making me alſo ignorant in my choyſe, that I ſhould give unto the world the weakeſt and imperfecteſt part of the projection of *Logarythmes,* and leave the beſt for another to write upon: Of which ſingle *Projection* with an *Index* at the *Center,* had I firſt writ upon and left the other way, which is the double *Projection* for ſome other to write upon: then might he have uſed not indirectly that comparative aſpertion of better. But before I writ of the *Naturall ſympathy* of this projection, I was not unadviſed which projection to preſent unto the *King*, and to the publike view of the *world* firſt, but conſidered intentively with my ſelfe the excellency of both wayes, and the more copious performance of the one, in reſpect of the other; And why I delivered it firſt in a *Ring*, was, for the aptneſſe and gentile-forme (as I may call it) it naturally might be caſt into. Secondly, for the excellent harmony, facility and expedition that the *Logarythmes* ſo projected did afford: having no ſecondary aſſiſtance to helpe it in operation; but the motion of the *Circle* it ſelfe, for there was nothing to do but to move one number to another in a proportion aſſigned, either in a double *Projection* in ſingle Circles, or the projection inlarged; and inſtantly there was preſented all other numbers in the ſame proportion; By an *Index* on a *Plate* in a ſingle *Projection* it was groſſe and courſe for the forme (in reſpect of a *Ring*) and for operation there muſt bee beſides extending the feet of the *Index* to the members, upon every ſeverall queſtion a new ſearch of numbers with a new motion (which extending of the feet of the *Index*, was the ſame with *Mr. Gunters Invention* of his *Ruler* and no new *invention*) Beſides if the ſingle Projection bee inlarged there doth neceſſarily adhere unto it ſundry & manifold obſervations in the way of operation by it, which cannot be avoided, which to a learner at the firſt ſeemes not a little harſh & difficult; all which the *Ring* or the way of the *Ring on a plate*, in the double *Proiectiõ* inlarged, doth naturally avoyd, and not only caries a facility in its operation; but retaines in it alſo a ſpeciall advantage in its performance, once rectified, for the *eye* and the *hand* may worke together, and what the *eye* finds in proportion, the *pen* may preſently expreſſe in *writing* without a ſecond trouble to ſearch out another number as before, and then to bring the edge of the *Index* to it. But ſome envious detractors would not admit of this forme and facility (though perhaps the ſucceeding times may) eyther as before to diſanull the worke, or for the difficultie that was found in an unexpert *workeman* in the true compoſing and *making of the worke*, for if the Circles on the *Ring*, or double *Projection on a plaine* being not exactly compoſed and graduated may cauſe ſome ſmall error in operation (which is onely from an excentricke motion) the ſingle *Projection* hath not onely the ſame defect, but alſo a ſecond to helpe it, to wit the *Index*, for by how much the legs of it are long and the Inſtrument large, by ſo much the more is it ſubject to errour, which is from a continued augmentation of an error in the fitting of it to a leſſer Circle which hath reference to a greater. *But* to paſſe by the errors that are ſubject to the beſt kinde of *Inſtruments* that can be made, let us a little examine the *Authors* & others compariſon of *Better*, why the way of the *Index* in a ſingle *Protection* is better then a mooveable and fixed Circle, which I conceive to have reference unto foure generalls about the *Inſtrument*. *Firſt*, either in the forme of the *Inſtrument*; *Secondly*, in the ordering of the Circles thereon; *Thirdly*, the expedition that is found in the practiſe thereof; And *fourthly* and laſtly, the copiouſneſſe of the uſes of the *Inſtrument*: and other cauſes I conceive not, why this ſingle Projection with an Index is better then a double, except it be in the magnitude that is now uſually made, or for the price of the *Inſtrument*: in the firſt there may bee an equall extendure of magnitudes unto both *Inſtruments*, and ſo as a thing common unto them, and no wiſe different. And for the price it may bee made as cheape, if not cheaper hereafter as I ſhall order it for theſe that affect them: Now in the firſt place as touching the forme, upon that I have ſpoken ſomewhat already, (as afore ſaid) and may be ſufficient: as for the *ſecond* generall touching that of the ordering of the Circles on this double projection, to have one *Circle mooveable* and one *Circle fixed*, that is agreeable to the projection and dividing of theſe Circles in the firſt direction following, according to the great *ſcheme* in the *Booke* noted with the letter *A*, for if the Circle of numbers noted with *N*, *N*, be cut through, and the Center of that *Circular plaine* be faſtned, ſo that it may move upon the Center of the other Circle, it ſhall fully repreſent the projection of my *Ring* upon a *Plaine*, to which may bee placed a ſmall ſingle Index as in the *ſcheme* of the title page *B*, to helpe the *eye* for the finding of oppoſite numbers; theſe *Circles* of the mooveable, or fixed *Circles* on the plaine are inſerted on both ſides of a *Ring* as it is ſpecified at the end of the dividing of theſe *Circles*. Now to have all the *Circles* placed upon one ſide of the R*ing* (as is according to the ſecond direction of making the *Ring*) were to leave the other ſide naked, without one would *patch* and *peece* ſome other thing on the other ſide, therefore to avoyde mixture, part of the projection (as an ornament) is placed on the other ſide, by which occaſion the whole projection at once is not viſible to the eye, as it would be in the ſecond way in accommodating the Circles into a *Ring*, as is in the double projection on a *Plaine* before mentioned, noted with *A*. But perhaps it may be objected that the Circles are eaſily continued on a *Plaine*, and the Index being at the Center the edge of it, doth accuratly cut each Circle in the proportionalls, which interſections in a *Ring* are defective and difficult to finde by the eye alone. To all which I anſvver, that the Circles in a *Ring* are as eaſy to be continued as on a *Plate*, allowing the mooveable and *fixed Circle* a ſufficient breadth, and here by the way I would have the *Reader* to underſtand that the *Circle* of *Tangents* being projected from 1.gr. unto 45.gr. is ſufficient for operation (theſe degrees being their complements to 90.gr. but for greater expedition in working they may be continued as is ſeene in the great *ſcheme A*, which continuation I learned not from another (as may bee ſuſpected by ſome) ſeeing I now publiſhed it after another, but long before that publication I inſtructed ſundry perſons upon that continuation by way of facility. As for the ſecond clauſe in ſuch Circles which are not upon the edge of the *mooveable* and *fixed Circle*, where the eye ſeemes to bee troubled to point out ſome oppoſite *numbers*, a ſmall edge of *metall* may eaſily ſupply that (as many uſe to doe) but the graduations being ſo neere the edge of the Circle, the proportionalls are ſufficiently given by the *eye* alone without ſuch an *edge*. Now if in theſe reſpects the *ſingle projection* with an Index, is better then that of a mooveable and fixed Circle being eaſily ſupplyed as aforeſaid, it is but a poore one, in common ſenſe. *But* if the way with an *Index* on a ſingle *Projection* bee not better then that of a double for the former reſpects, then it may bee in the third *generall* to wit the *Inſtrumentall* expedition: in which there needes little declaration to prove the double Projection to have a greater expedition then the ſingle projection with an Index, ſeeing it appeares ſo obvious, that what can be quicker, then having mooved one *number* to another in proportion aſſigned, that all other *numbers* are oppoſite one to another in the like projection (which a ſingle *Index* doth point out eaſily to the eye as before.) By the Index in a ſingle projection there is firſt putting the one foot to one *number*. and extending the other foot to another *number*. then muſt the *eye* have reference to one of the *feete* that it fall upon his third *number*, and afterward to looke for the ſecond *foote* for the fourth *number*, and ſo to move it to another number, and ſtill to have a double reſpect with the eye as before in every new operation: in this regard alſo I ſee not why the way of an Index in a ſingle *Projection* is better then that which I have delivered in a double *projection*. *But* to paſſe by all the former generalls as triviall and of ſmall conſequence, let us weigh ſeriouſly things more materiall touching both wayes of theſe *Inſtruments*. If the ſaid ſingle projection on a *plate* with an Index at the Center bee not better in reſpect of its *expedition in operation*, then muſt it neceſſarily bee (to prove the *Authors aſſertion*) in the *Inſtruments* fourth generall, to wit, in its copious *performance*, which I hold eyther to be in the generall, or particular uſe; In the generall I conſidered the finding of *proportionalls*, and thats agreeable to the way of operation in either *Inſtruments* as is afore ſpecified; In the particular I regard alſo what propoſitions offer themſelves to the eye, eyther by motion, or without motion: by motion it is impoſſible for the ſingle *projection without an Index* being opened at pleaſure to give any more then one kind of proportionalls, the *Ring*, or a mooveable and fixed Circle on a Plaine, *ſcorning* as it were ſuch *lameneſſe*, or ſuch an injurious tie from its naturall propertie, ſheweth by motion infinite operations in various proportionalls, even through the whole body of the *practicall* part of *Mathematicall Art*, which would be too copious for me to declare, or for the *Readers* patience to peruſe, onely ſome common uſes by ſuch motion I will deliver, ſomewhat to prove my aſſertion, that the *ſingle projection* with an Index, is not better then that with a *moveable and fixed Circle*, therefore,

1. *Firſt*, the *moveable* being moved about at pleaſure, as 1. in the *moveable* paſſeth by any *multiplier* in the *fixed*, ſo doth any *multiplicand* in the moveable, point out its product in the *fixed*, or contrarily, as any *diviſor* in the *moveable* doth paſſe by, 1. in the *fixed*, ſo doth any *dividend* in the *moveable* point out his *quotient* in the *fixed*, ſo as 12. (*the months in a yeare*) or 52. (*the weekes in a yeare*) or as 365. (*the dayes in a yeare*) in the *moveable* in motion doth paſſe by 1. in the *fixed*, ſo any ſumme of money in the *moveable*, doth point out its *monthly, weekely*, or *dayly expences* in the *fixed*.

2. *Secondly*, as 7. in the *moveable* doth paſſe by 22. in the fixed (*Archimedes Proportion* betweene the *diameter* of a *Circle* and its *Circumference*,) ſo doth any *diameter* in the *moveable*, point out its *Circumference* in the fixed, *vel contra*.

3. *Thirdly*, as a hundred waight of any commodity in the *moveable*, (or any other *waight or meaſure*) paſſeth by its price under 100. pound in the *fixed*, ſo right againſt 1. in the *moveable*, is the price of a pound waight of that commodity amongſt the *decimals* in the fixed *vel contra*.

4. *Fourthly*, the *moveable* being moved about at pleaſure, the *Intereſt* of all *ſummes of money* according to any rate in the hundred is given;

for as 100, in the *moveable* paſſeth by its *intereſt* in the fixed, ſo every ſumme of money in the *moveable*, doth point out its intereſt in the fixed, *vel contra*.

5. *Fiftly*, as 1. in the *moveable* paſſeth by any ſum of money in the fixed, ſo any number of *yeares* in the *Circle of yeares*, doth point out the amount of that money in the fixed, according to the terme of yeares that the money was forborne.

6. *Sixtly*, as the meaſure of a ſide, of any dimenſion, of a *Building*, of a *Fortification*, of a whole mixture, or the weight of it, &c. in the moveable paſſeth by a greater, or leſſer *meaſure*, or *waight* in the fixed (*in homogeniall things*) ſo the meaſures of the parts of any of theſe wholes in the *moveable* will point out in the fixed the proportionall parts of any other *whole* by way of *augmentation*, or *diminution*.

7. *Seaventhly*, as 1. in the *moveable* paſſeth by the *ſquare* of the ſide of any of the tenne *regular Plaines*, ſo doth each *plaine* note in the *moveable* point out right againſt it, its *Area* in the fixed; and as any kinde of meaſure to the *Pole* in the moveable, paſſeth by its quantity in the fixed, ſo doth any other kinde of *Pole* point out its quantity or *Area*, being meaſured by that *Pole*, &c. and whatſoever may be attributed to the uſe of this *Circle of numbers* may be given by motion.

Further, if we conſider the *Circle* of *Sines* and *Tangents* conjoyned with the *Circle of Numbers* in operation, or the *Sines* with themſelves or joyned with the *Tangents*, then by motion you have the *ſides* and *Angles* of infinite *plaines* and *Sphericall Triangles* for practicall uſes, either in *Geometrie, Aſtronomie, Navigation, Fortification, Horologographie, Geographie, &c.*

1. *Firſt*, as the *ſine* of 90. paſſeth by 60. in the fixed amongſt the *numbers*, ſo the ſine *complement* of any degree in the *mooveable* will point out the *miles* anſwerable to any degree of *Longitude* in the *Latitude*; and as the ſaid 90. paſſeth by the *Tropicall point*, in the *fixed*, ſo the *ſine* of any degree of the *Sunnes diſtance* from the *Equinoctiall point*, will point out the ſine of the *ſunnes declination* anſwerable to that diſtance.

2. *Secondly*, as the *ſine* of any *Rumbe* in the mooveable from the *Eaſt* or *Weſt*, ſayled upon, paſſeth by the meaſure of a degree in *leagues* or *miles* in the fixed, ſo 1. in the *mooveable* pointeth out in the fixed the number of *miles*, or *leagues* to raiſe or depreſſe the *pole* a degree in that *Latitude*.

3. *Thirdly*, as the *ſine* of any *Latitude* in the *mooveable*, paſſeth by

the

ſine of the *Tropicall* point in the fixed, ſo the *ſine* of the *Sunnes* diſtance from the *Equinoctiall points* in the *mooveable*, that paſſeth by the *ſine* of 90. in the fixed, doth point out the *ſine* of the *Sunnes* greateſt degree of the diſtance from the *Equinoctiall points* that the *Sunne* will bee due *Eaſt* in that *Latitude*.

4. *Fourthly*, as the *ſine* of 90. in the *mooveable* paſſeth by the *ſine Complement* of any *Latitude* in the fixed, ſo right againſt the *ſine Complement* of all *Declining plaines* in that *Latitude* in the *mooveable*, are the ſines of the degrees of the *ſtiles heights* in *Horologographie* agreeable to theſe *declining plaines* in the *fixed*.

5. *Fiftly*, as the *ſine Complement* of any *Latitude* in the mooveble paſſes by the *Tropicall point* in the *fixed*, ſo the ſine of the *Suns diſtance* from eyther of the *Equinoctionall points*, will point out right againſt them the ſines of the Suns *Amplitude*.

6. *Sixtly*, as the *Tangent complement* of any *Latitude* in the *mooveable* paſſeth by the ſine of 90, in the *fixed*, ſo the *Tangent* of the *Tropicall point* in the mooveable, doth point out in the fixed the ſine of the greateſt *difference of aſcention* for that *Latitude*

7. *Seventhly*, as the ſine of the *Suns poſition* at his *ſetting* or *riſing*, or the ſine of the *houre* from 6. at that inſtant in the *mooveable* paſſeth by the ſine of 90. ſo the ſine of the *Suns declination* in the former, & the *Tangent* of that *declination* in the latter, will point out the ſine of the height of the Equinoctiall in the former, but the *Tangent* of the ſame in the latter.

In this nature you have infinit operations performed by *motion* in this double *Projection* of a *mooveable* and *fixed Circle*, which by a ſingle *Proiection* with an *Index* cannot as before poſſibly be performed, therefore if in this regard the way of the *Index* on a ſingle *Proiection* bee not better but is farre inferiour to that of a *mooveable* and *fixed Circle*; to prove the *Authors* and others *divulged aſſertion*, then muſt it be better in the laſt clauſe, which was the *Inſtrumentall* performance without motion, in which the *ſingle projection* with an *Index*, comes very ſhort of other *Inſtruments* which by a ſingle *inſpection* of the *eye* ſhewes many pleaſant, and uſefull propoſitions. But this none, or very few at all, as onely the *Logarithmes*

mes of *numbers,* the *naturall ſines* and the *Tangents* of the Logarythmall,&c.But the double *projection* with a *mooveable* and *fixed Circle* doth not onely ſhew that, but being at any poſition carries with it ſuch an *excellencie* that it aſſumes unto it ſelfe a prehemenencie above any *Inſtrument* never yet produced in regard of its copious uſe, & manifold performances which it affords without motion as by an *inſpection of the eye onely*: a touch of wch I will unfould & *unvaile* which never yet came to a publik view.

1. *Firſt*,the *Inſtrument* lying upon a *Table* open to the *eye* and being at any poſition, marke what numbers in the *mooveable* and *fixed* are oppoſite one unto another, according to which *proportion* there is repreſented infinite other *proportionalls*,in the ſame *proportion,* for one number is oppoſite to another through the whole *Circle of numbers,ſines*,and *Tangents,* from which one might apply the *proportionalls* in *numbers* to the uſe of things, to *expences*,to *proportions in Buildings,* to *fortifications, menſurations*,but too great a prolix diſcovery would tyre the *Reader* in that which he may eaſily from it apply hereafter unto himſelfe.

2. *Secondly*,marke what number in the *fixed*,(in the *Circle of numbers)* is againſt any number of *yeares* in the *mooveable*,which ſuppoſe a Legacie to be payd for ſo many *yeares* to come or a *ſumme of money* forborne ſo long time; and it were to be ſold for preſent *money*,right againſt 1. in the mooveable, is the worth in preſent of that *Legacie* or ſumme of money in the *fixed.*

3. *Thirdly,* in *Horologographie,* you have the diſtance of the *houres* in a *poler,* and *Meridionall plaine,* without operation,for marke what number in the *Circle of numbers* in the *fixed* is againſt the *Tangent* of 45.gr.in the *mooveable*(which number in the *fixed* may be ſuppoſed the meaſure in inches,&c.of the *ſtiles hight*) ſo right againſt the *Tangent* of the *equall houres* in the *mooveable* you have the *houre diſtances* in the *Circle of Numbers in the fixed.*

4. *Fourthly*,the *houres* of a *Horizontall* or *verticall dyall,* for ſome one *Latitude* or other is ſhewne, for marke what degree amongſt the *ſines* in the *fixed* (which repreſents the *Latitude)* is againſt the *ſine* of 90. in the *mooveable*,ſo the *Tangent* of the equall *houres* in the *mooveable,* doth point

out

cut the *houre* diſtances (for that *Latitude*) amongſt the *Tangents* in the fixed, and theſe *houres* ſerve for a *verticall Dyall* in the *complement* of that *Latitude*.

5. *Fiftly*, note what number in the *fixed* in the *Circle of Numbers*, is againſt 1. in the mooveable (which ſuppoſe to be the given ſide of any of the *ten regular figures*) then againſt the *circumſcribing* and *inſcribing* notes of theſe *regular figures* in the mooveable is the *Circles circumſcribed* and *inſcribed diameters* of thoſe *regular figures*: But if the ſaid number in the *fixed* againſt 1. in the mooveable be taken for the *ſquare* of the ſide of the *diameter*, of the ſide of any of the *ten regular figures*, then againſt the *Regular notes* in the mooveable, is the *Area* of theſe *figures* in the *fixed*.

6. *Sixtly* note what *numbers* in the *Circle of numbers* in the *fixed*, are againſt the *regular figuratiue* notes of *equality* in the *moveable*, ſuch are the ſides of thoſe *figures* whoſe *quantities are equall* the one to the other: In like manner the numbers in the *fixed* againſt the notes of the *Regular bodies* in the *mooveable* repreſenteth the ſides of theſe *bodies* which have equall *ſolidities* the one unto another.

7. *Seventhly*, you have infinite oblique angled *plaine Triangles* repreſented, and ſuch who have equall *Altitudes* but different *Baſis* the ſides of ſeverall *parallelograms*, equall unto one and the ſame *ſquare* or the quantitie of a *Triangle* given in Acres, the perpendicular and Baſe is alſo given: For firſt the *ſines* of the *Angles* on the mooveable will point out their *ſides* of the Triangle amongſt the *numbers* in the *fixed*, *vel contra*.

And *ſecondly*, marke what number in the *mooveable* in the *Circle of numbers* is againſt 1. in the *fixed* that ſuppoſe to be the *Altitude* of a *Triangle*, then the equall diſtances from 1. on both ſides of it taken at pleaſure in the *fixed* will point out in the *mooveable* the ſegments of the *Baſis* of the *Triangle*, or the ſides of a *parallelograme* equall unto the ſquare made of the *Triangles* perpendicular. And *thirdly*, the quantitie of the *Triangle* in the *fixed* amongſt the numbers doth point out the *Baſis* of the *Triangle* in the mooveable, and that number in the fixed which is againſt *AC*, (in the mooveable) is the *Triangles* halfe perpendicular according to the *Area* given.

8. *Eightly*, marke what number in the *fixed*, is againſt 1. in the *mooveable*, which ſuppoſe to be the ſide of any of the *Regular bodies*, then right againſt the ſolids *inſcribed* notes in the *mooveable*, are their *ſphears circumſcribing diameters*, but if the ſaid number in the *fixed* be ſuppoſed to be the *ſemediameter* of a *ſpheare*, the numbers in the *fixed* (in the Circle of numbers) againſt the *ſolids circumſcribed* notes in the *mooveable* ſhewes the ſides of theſe regular *bodies* that will circumſcribe that *ſpheare*.

9. *Ninthly*, marke what number in the *fixed* amongſt the *Numbers* is againſt 1. in the mooveable which may be ſuppoſed the *diameter* of a *Circle*, the *Axis* of a *ſpheare*, the ſide of a *plaine figure*, or that of a *ſolid* body: ſo the numbers in the *fixed* in the *Circle of numbers* againſt the *potentiall* notes in the *mooveable* ſhall repreſent the *diameter*, *Axis*, or ſide of its *homogeniall figure*, or *ſolid*, according to the proportion of theſe potentiall notes in the *mooveable*.

10. *Tenthly*, marke what numbers in the *Circle of numbers* in the *fixed* are againſt the notes of the regular figures, ſuch ſhall bee their Areas, and the numbers in the *fixed* againſt the regular *Bodies convexities*, ſuch is their ſuperficiall *convexitie*: and the number in the *fixed* againſt 1. in the *mooveable*, is the *ſquare* of one of the ſides of the regular figures, or the ſides of one of theſe *bodies*, and what numbers in the *fixed* are againſt the notes of the ſolid *bodies*, ſuch ſhall be the ſeverall *ſolidities*, or contents of theſe regular *bodies*, and the number in the *fixed* againſt 1. in the *mooveable* is the *Cube* of the *ſides* of theſe bodies.

Laſtly, moſt courteous *Reader*, (not in any braving flouriſhes or branding any of the *Nobilitie* or *Gentry* with the attribute of *jugling*, againſt the ſimple *modeſtie of the Author*,) I have in ſome meaſure ſupported their *honours* in that particular in the Epiſtle at the end of this *Booke*: and that wee may ſay ſomething more upon the excellencie of this *Inſtrument* without multiplying of tautologized and needeleſſe prefixed *graduall numbers*, or *Circuitions*, if not Circumlocutions, in the naked truth of this *Inſtrumentall proiection*, according to its naturall propertie. The *Roots* of all *ſquare* and *cubicke* numbers without partition are given; and that by an inſpection of the *eye* onely.

Thus I might have extended my ſelfe more copiouſly in the excellent uſe of this my *mooveable* and *fixed Circle*, and even from the *Inſtrumentall* poſition by an inſpection of the eye onely without motion, compile a large *Booke* of its ample *performance*, but in that which I have delivered I have onely but ſcatteringly glanced upon things, as making way for *many occaſions*, and as a motive to a further inquiry: Its an ancient proverbe amongſt us, *good wine needs no Buſh*, but the *wine* muſt not be faſt lockt up then, that none can come by it; if ſo it wants both *buſh* and *key*; and to ſome ſuch needeleſſe expreſſions might be avoided, the *Inſtruments* owne excellency will to the more learned eaſily preſent it ſelfe that which I have publiſhed: concerning it, I glory not in, but onely deſire to ſatisfie thoſe who would ſee the difference of both wayes, with, and without a *mooveable Circle*, & to let others know the truth of things which are conceated, and carryed away with opinion onely, that the way of the *Index* on a ſingle *proiection* is better then the way of a *mooveable* and *fixed Circle*, which both in regard of expedition as alſo copiouſneſſe of the *Inſtrumentall* uſe, by *motion* or without *motion* comes ſhort of the other. What meanes the *Authors divulgation* then, that the way of the *Index* is better then the way of a *mooveable* and *fixed Circle*, I know not, whoſe *knowne skill* in the whole *Syſteme of Mathematicall* learning will eaſily free him from the ſuſpicion, that the way can be made, on the ſubject *unvailed* for him.

But I have now a little more made bold to *unvaile* the ſubiect for ſome, in the copious declaration of the excellent uſe of this *Logarythmall projection Circular* by a mooveable and fixed Circle, and alſo in its inlargement, which hitherto lay in obſcurity, and as a generall benefit to thoſe that affect the way of this *Inſtrumentall practiſe*. It were good that the divulgers would prove their aſpertions, touching the word *better*, that others might participate ſubſtancially of their better way by the *Inſtrumentall* performance, eyther by *motion*, or without *motion*, and not to allure the world by a bare exhortation, unto the affection of the one *Inſtrument*, and by a dehortation to beate downe the uſe of the other, which ſavours of too high a conceite of the one, and too great a detraction from the other; Too great & too looſe an *aſpertion* hath bin caſt upon me about theſe things, which I never thought in the leaſt title when I firſt writ upon this Invention, or my name ſo to come to the *worlds rumor* as it hath ſince the laſt publication of this *Logarythmall projection Circular*; howſoever, here is my comfort, the guiltleſneſſe and innocency of my cauſe, which may teach me, and others carefulneſſe hereafter, how and what we publiſh to the world, ſeeing there are ſuch *carpers*, and *maligners* even of the moſt uſefull and *beſt things*, yea, ſuch buſie bodies who marre that which others make, who ſcorne to have a ſecond, knowing all things and admiring nothing but themſelves, ſuch who have ſtings like *Bees*, and *Arrowes* alwayes ready to ſhoot againſt theſe whom they diſlike, ſuch who while they will needs have many *callings* neglect their owne; ſharpe wittie *cryticks*, *Diogenes like*, ſnarling at others, and not looking home unto themſelves, but by all meanes endevouring to take away the *mantle of peace*, and rent the ſeameleſſe coate of *love* and *amitie*. If things be not done well by others then they triumph and ſend forth their invectives, if well, they profeſſe it nothing, and cannot paſſe without their cenſure. To ſpeake ill of a *man* upon knowledge ſhewes want of *Charity*; but to raiſe a ſcandall upon a bare ſuppoſition, & to act it in *Print*, argueth little *humanity*, leſſe *chriſtianity*: but enough of this if not too much, I am ſure ſome have taſted too much already; perhaps others hereafter may helpe to bare a *ſhare*, for my owne part I deſire no favour but the *truth* and equitie of my *cauſe*, and the due *waighing* of things with their reall *circumſtances*. *Veritas non quærit Angulos*. I deſire no ſhifting, or pretences, but if I have done others wrong let me *ſuffer*; If I have beene *wronged* by others let me have *truth*, and *right* done me, thats all I *require*. Who am

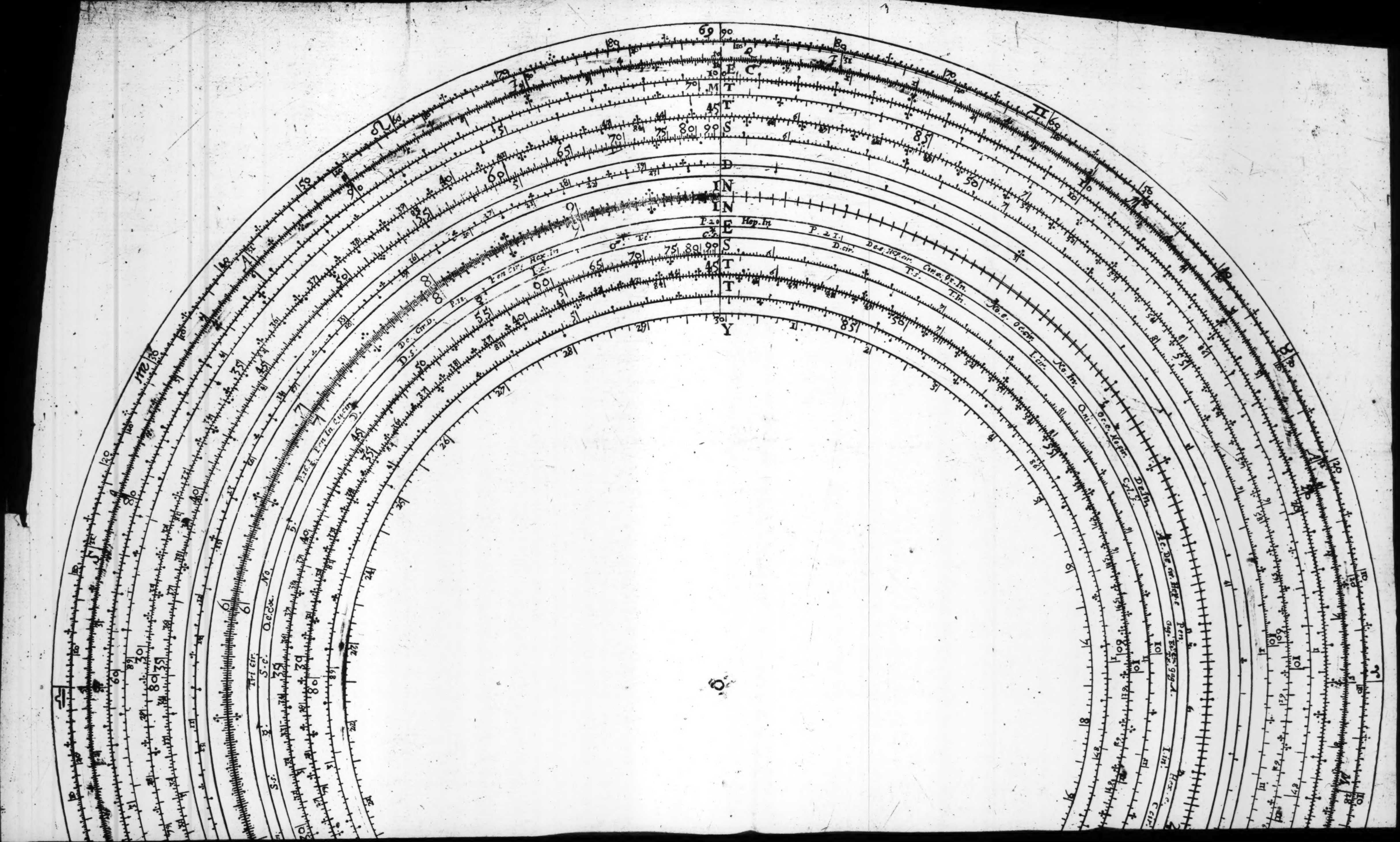
An ever well wiſher
to the truth and thee.

R. D.

S*Ince my firſt publication of the uſes of my* Mathematicall Ring *or the* Logarythmes *projected* Circular, *I have beene oftentimes invited by ſundry* perſons *for the way of the* projecting, *and* dividing *of the* Circles of my Ring *upon a* Plaine, *ſo that it might be made in* Paſtboard *to avoyde the charge of the* Inſtrument *in metal, for ſuch which have not abilities to buy, and for others, who would firſt ſee the practiſe on it, before they would be at the coſt of the* Inſtrument *in metal: for whoſe ſake, and uſe, deſiring to ſatisfie the affectionate, and for a publike benefit, (rather then ayming at mine owne particular profit) I have cauſed two* Plates *of metal to be cut & ingraved, the one containing the* Circles *of the* Projection *of my* Ring, *to bee uſed on a* Plaine *as it is there deſcribed, noted with the letter* A. *and the other comprehending that* Projection inlarged, *noted with the letter* B: *that ſo ſuch may make uſe of them more readily, to avoid the labour of dividing the* Circles;

which ſchemes *being paſted on a* Paſtboard *are ready for uſe.*

And yet further to ſatisfie thoſe that are deſirous, I have delivered alſo in the firſt place inſuing, how thoſe Circles *are projected & divided, that ſo they may be made according to any* magnitude. *In the ſecond place how ſeverall wayes they may bee framed in a* Ring: *In the third place J ſhew the inlarging of the* Inſtrumentall Invention *in theſe* Circles *to as great a* magnitude *for uſe as may be deſired. Jn the fourth place J deliver ſeverall wayes how theſe* Circles *inlarged may bee accommodated for* Practicall uſe. *Jn the fift place, I make a deſcription of the* Grammelogia, *or* Inſtrument *in the particular* Circle *of my* Mathematicall Ring, *projected on a mooveable and fixed plaine, to wit, of the former ſcheme* A. *And in the ſixt and laſt place, J will declare the excellent uſes of both theſe* Inſtruments, *in the* Practicall *parts of* Arithmeticke, Geometrie, Aſtronomy, Horolographie, Navigation, &c.



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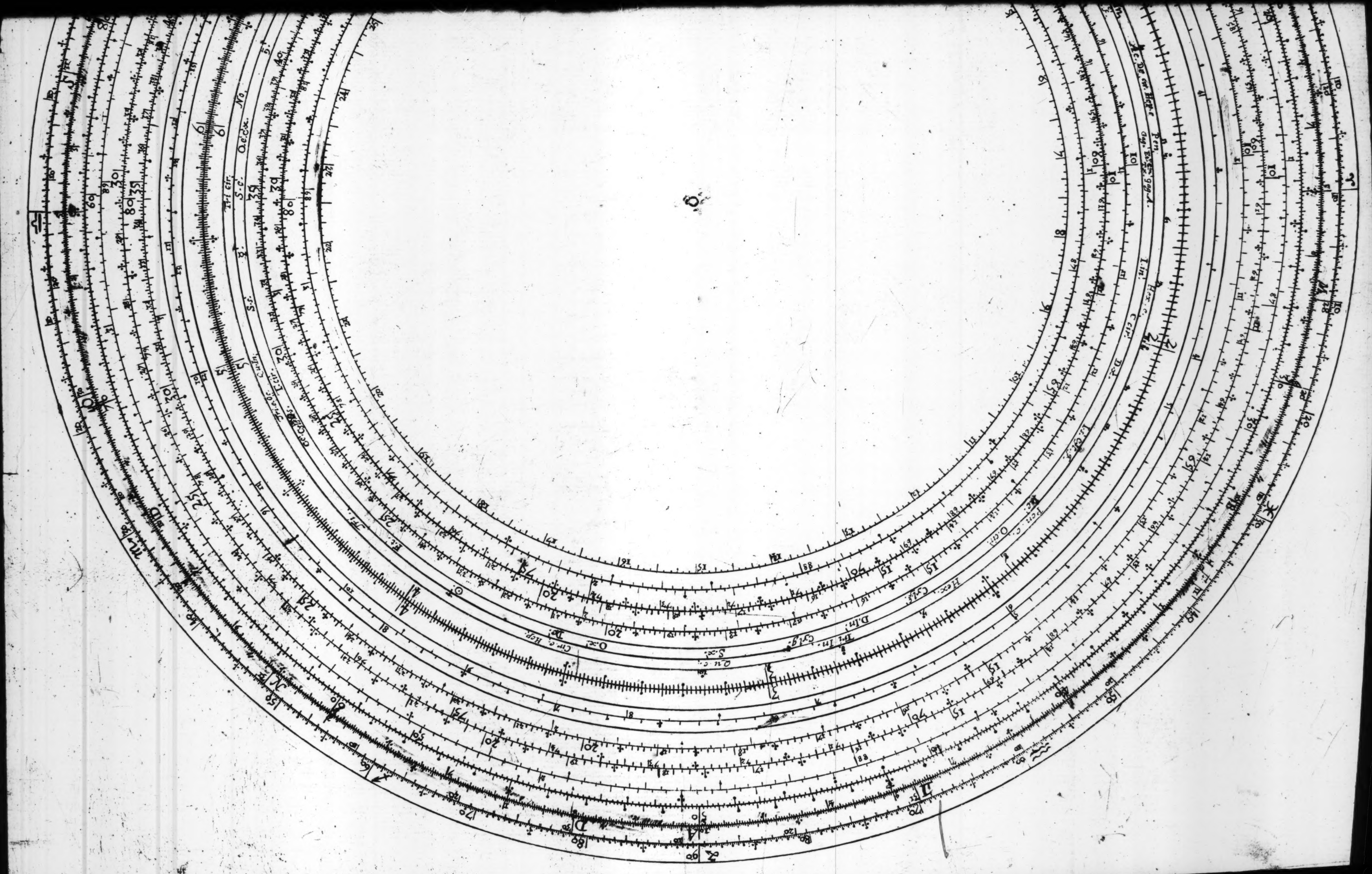

Of the projecting and dividing of the Circles of the Mathematicall Ring, and of the inlargement of the Invention, either in a ſingle projection, or in a double, and that ſeverall wayes.

F*Or the firſt*, according to any ſemediameter deſcribe ſeverall *Circles* concentricall, as here are repreſented by the figure *A*, the outmoſt of which may be noted with the letter *E*, ſerving for the *Circle of equall parts*, and be divided into 100. 1000. or 10000. equall parts according to the capacity of the Circle, and noted with figures thus, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100.

The next two *Circles* may be noted with the letters *T T*. which may be for the *Circle of Tangents*; unto the next Circle may bee ſet the letter *S*, which may repreſent the Circle of Sines, and the inner Circle may bee noted with the letter *N*, which may repreſent the *Circle* of *Numbers*: Theſe *Circles* of *Numbers*, *Sines* and *Tangents*, may bee divided out of the Table of the *Logarythmes of Numbers*, of *Sines*, and of *Tangents*, in this manner following.

1. Of the graduation of the Circle of Numbers.

First, to divide the *Circle of Numbers*, marke what number there is againſt 2. in the Table of *Logarythmes*, which is 3010. and account it from *E*, in the *Circle of equall parts*, (if the Circle be divided into 10000. equall parts, but if the Circle be divided but into 1000. equall parts, then account onely 301. parts) which is againſt 2. in the *Table of Logarythmes* (as aforeſaid) and will bee at *α*, lay a Ruler upon it and the Center, and interſect the Circle of *Numbers N*, in 2. then marke what number is againſt 3. in the *Table of Logarythmes*, which is 4771. and account it from E in the ſaid *Circle of equall parts*, viz. at *β*. and lay the *Ruler* upon the *Center*, and to the ſaid 4771. or at *β*, and interſect the Circle of *Numbers N*, in 3. Againe from *E*, account 60, 20. viz. at *γ* which is againſt 4. in the *Table of Logarythmes*, and lay the Ruler thereto, and interſect the Circles of Numbers *N*, in 4. and ſo proceede untill you come to 10. ſo the interſections in the Circle of Numbers, *N*, noted thus, 1, 2, 3, 4, 5, 6, 7, 8, 9. ſhall be the capitall diviſions of that *Circle*.

Then may the ſpaces betweene 1, and 2. betweene 2, and 3, &c. be ſubdivided by the conſequent numbers in the *Table of Logarythmes* thus.

Marke what number is againſt 11. in the *Table of Logarythmes*, which is 413. account this number from E. in the *Circle of equall parts*, viz, at *δ*, and laying a Ruler upon the *Center A*, and the ſaid *δ*, or 413. note the *Circle* of numbers *N*, in *ε*, then marke what number is againſt 12. in the *Table of Logarythmes*, which is 791. account it from E. in the *Circle of equall parts*, viz. at *ζ*. and lay a Ruler upon it and the Center, cut the *Circle N*, in *η*. and ſo goe on untill you have divided the whole ſpace betweene 1, and 2. which will be when you come to 20. againſt which in the *Table of Logarythmes* is 13010, &c. the ſame with the *Logarythme* againſt 2, viz. 03010. the figure of 1. (the Index) being rejected, which 1, repreſents one whole revolution: In like manner you may divide the ſpace betweene 2, and 3. in the Circle of Numbers *N*. from the

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Logarythmes which are againſt the *Numbers* betweene 20. and 30. and ſo of the reſt of the ſpaces betweene 3. and 4. betweene 4, and 5, &c. untill you come to 1, which repreſents 100. then if you will ſubdivide the ſpace betweene *N*, and ε, marke what number is againſt 101. in the *Table of Logarythmes* which is 43, account this from *E*, viz. at ϑ, and lay a Ruler upon it and the Center and cut the *Circle N*, in ι. then marke what number is againſt 102. which is 86. account it alſo from *E*, in the Circle of equall parts; and lay a Ruler upon it and the *Center*, and cut the *Circle* of Numbers *N*: in λ, and ſo goe on, untill you come to ε, which will be at 110. and the *Logarythme* againſt which is 413. the ſame which before was againſt 11. (the Index in each being rejected) which repreſents as before onely the ſeverall Revolutions. In like manner may be divided the ſpace betweene ε, and η, in the Circle of Numbers *N* out of the *Logarythme* betweene 100, and 200. and ſo of the reſt: But if the *Inſtrument* be large then it is requiſite to divide the ſpace betweene *N*, and ι, betweene ι, and λ, &c. which will bee from the *Logarythmes* which are betweene 1000. and a 10000. Therefore in a ſmall *Inſtrument* you may begin to divide it at the *Logarythme* of 101. untill you come to 1000. but in *Inſtruments* more large begin from the *Logarythme* of 1001, untill you come unto 10000. and if the diviſions fall large at the beginning, they may be divided ſucceſſively from 10001. untill you come unto 100000.

And thus for the graduating and dividing of the *Circles of Numbers*; which I adviſe any one (that intends to graduate the other *Circles*, viz. that of the *Sines*, and *Tangents*,) that he fully underſtand & conceive this former direction, otherwiſe he will not ſo eaſily apprehend the graduations of the ſaid *Circle of Sines*, and *Tangents* nor how to divide the projection inlarged; therefore I have indeavoured to be very plaine in the opening of the originall of the worke, that ſo the enſuing more compendiouſly may be conceaved.

2. Of the graduation of the Circle of Sines.

2. *To divide the Circle of Sines*, you ought to have refe-

rence to the *Table of Sines,* and the worke for the graduation of it is in a manner nothing different from the former, onely here may be noted, whereas all the *Logarythmes* of *Numbers* are comprehended under one abſolute revolution of a *Circle*, the *Sines* (which are ſufficient for practiſe) will comprehend or require two revolutions; The firſt of which begins at the *Line of Conjunction,* E N, from S, at 34. m. 24. ſ. and ends its revolution at 5. gr. 44. m. 22. ſ. and then begins againe at the ſaid 5. gr. 44. m. 22. ſ. and ends at 90. gr. and is divided thus: *In the Table of Sines*; marke what number is againſt 1. gr. under the title *Sines*, which is 8. 2418. (the Index 8. being rejected) of which account onely but 2418. from E, viz. at *a*, and lay a Ruler upon the *Center*, and upon the ſaid *a*, or the Number 2418. and interſect the *Circle of Sines* upon the inſide in 1, which repreſents 1, gr. then marke what number is againſt 2. gr. under the title *Sines*, which is 5428. account this from E, in the *Circle of equall parts*, viz. at *b*, and lay a Ruler upon it and cut the *Circle of Sines* upon the inſide, as before in 2, which ſtands for 2, gr, and ſo proceede untill you come to the *Line of Conjunction* E, N. according to which direction you may ſubdivide thoſe degrees out of the ſaid *Table of Sines*, into minuts, 5ths. of minuts 10ths of minuts, &c. according to the greatneſſe or ſmalneſſe of the *Inſtrument*: The inner ſide of the *Circle of Sines* being thus divided, marke what number is againſt 6, gr. under the title *Sines*, which is 192. (the Index being rejected) account this number from E. in the Circle of equall parts, viz. at *e* and lay a Ruler thereto and the Center, and interſect the Circle of Sines S. on the outſide in 6. gr. then marke what number is againſt 7. whith is 858, account from E, in the *Circle of equall parts*, viz. at *f*, and lay a Ruler thereto and interſect the *Circle of Sines* S, in 7. gr. and ſo proceede untill the whole *Circle of Sines* be divided into its degrees and parts, unto 90.

Of the graduation of the Circles of Tangents.

3 *To divide the Circle of Tangents*, you muſt have reference alſo to the *Table of Logarythmall Tangents*, as followeth.

Looke in the Table for 1. gr. and marke what *Number* is againſt it under the title *Tangents*,viz. 2419.(the Index being rejected) then account this number 2419. from E, viz.at *a*,and lay the Ruler upon it,& the *Center*,& interſect the lower *Circle of Tangents T*, on the outſide in 1, which is oppoſite to 1.gr. in the Sines, and repreſenteth the *Tangent* of 1.gr.then from E,account 5430.which is the *Tangent* of 2.gr.& lay a Ruler upon it & the *Center*,& interſect the *Circle T*,in the outſide which ſhall repreſent 2.gr.in that *Circle*, and ſo goe on untill you come to *the line of Conjunction*, which will bee at 5.gr.42.m.40.ſ. then marke what number is againſt 6.gr. under the title *Tangents* which is 216. account this Number from E, in the *Circle* of equall parts,viz. at *e*, and lay a Ruler upon it and the *Center*,and cut the *Circle of Tangents T*,on the outſide of it in 6.gr.then looke what number is againſt 7.gr. under the title *Tangent* which is 891. account it alſo from E,in the *Circle* of equall parts,viz.at *f*, and lay a Ruler upon it,and interſect the *Circle of Tangents* on the upper ſide in 7.gr. in like manner goe on in dividing the reſt of the ſpace in the degrees and parts,unto *the line of Conjunction* which will be at 45.gr. Then marke what Number belongs to the *Tangent* of 46. which is 100151. (reject the Index 10.) and the number 151.account from E, in the *Circle of equall parts*,viz.at *g*, and lay the Ruler upon the *Center*, and interſect the *Circle of Tangents T*, on the inner ſide in 46.gr. then looke for the *Tangent* of 47.gr. which is 100303.but (the Index being rejected)it is but 303.account this *Number* from E,*in the Circle of equall parts*,viz. at *h*, and lay a Ruler upon it, and the *Center*, and cut the *Circle of Tangents T*,on the inner ſide in 47.gr. and ſo goe on in dividing the inner ſide of this *Circle* untill you come to *the line of Conjunction*, which will be at 84.gr.17.m. 21.ſ. then ſeeke for the *Tangent* of 85,gr.which is 110580 reject the *Index* which is 11. and account 580. from *the line of Conjunction* in the *Circle of equall parts*, from E.viz. at 1.and lay a Ruler upon it, and the *Center*, and cut the lower *Circle T*,upon the inner ſide in 85.gr.and ſo proceede with the reſt of the graduations untill you come to *the line of Conjunction*, which will be at 89.gr.25.m.40.ſ.

☞ Theſe laſt graduations of *Tangents* from 45. gr. unto the ſaid 89.gr. 25.m.40.ſ. are not out of any neceſſity to be inſerted, but for expedition, in operation, and are onely the complements of the former, ſo the complement of the *Tangent* of 40.gr. is 50.gr. the middle ſpace betweene which is 45. againe, the complement of the *Tangent* of 35. is 55. the middle of which is at 45. Now the diſtance betweene 50. and 45. is the ſame betweene 40. and 45. and ſo of the reſt.

How the Ring may be framed or compoſed.

Thus for the ſingle projection of the *Circles of my Ring*, and the dividing and graduating of them: which may bee ſo inſerted upon the edges of *Circles* of mettle turned in the forme of a *Ring*, ſo that one *Circle* may moove betweene two fixed, by helpe of two ſtayes, then may there be graduated on the *face of the Ring*, upon the outer edge of the mooveable and inner edge of the fixed, *the Circle of Numbers*, then upon the inner edge of that mooveable Circle, and the outward edge of that inner fixed Circle may be inſerted *the Circle of Sines*, and ſo according to the deſcription of thoſe that are uſually made.

If you bring 1. in the mooveable amongſt the *Numbers* to 1, in the fixed, you may on the other edge of the mooveable and fixed ſee the *Sines* noted thus, 90,90.80,80.70, 70,&c. unto 6,6. and each degree ſubdivided, and then over the former diviſion and figures, 90,90.80,80.70,70. &c. you have the other degrees, viz. 5, 4, 3, 2, 1. each of thoſe are divided and ſubdivided by ſeverall points.

Secondly, (if the *Ring* be great) neare the outward edge of the ſide of the fixed, againſt the Numbers, are the uſuall diviſions of a *Circle*, and the points of the *Compaſſe*: ſerving for obſervations in *Aſtronomy*, *or Geometrie*, and the *ſights* belonging to the Ring may bee placed on the mooveable *Circle*.

Thirdly, oppoſite to theſe *Sines* on the other ſide are the *Logarythmall Tangents*, noted alike both in the mooveable; and fixed, thus, 6 6.7 7.8 8.9 9.10 10.15 15.20 20. &c. unto 45.45. which numbers or diviſions ſerve alſo for their complements to 90.as before: ſo 40,gr.ſtands for 50. gr. 30.gr.for 6c,gr. 20.for 70.&c. and each degree heere both in the mooveable and fixed is alſo divided into parts; as for the degrees which are under 6.viz.5,4.3,2,1. they are noted with ſmall figures above this divided *Circle* from 45.40, 35,30,25,&c. and each of thoſe degrees is divided into parts by ſmall points, both in the mooveable and in the fixed Circles.

Fourthly, on the other edge of the mooveable on the ſame ſide is another graduation of *Tangents*, like to that formerly deſcribed. And oppoſite unto it in the fixed is a graduation of *Logarythmall Sines*, in every thing anſwerable to the firſt deſcription of *Sines* on the other ſide.

Fiftly, on the edge of the *Ring* is graduated a part of the *Equator* numbred thus, 10,20,30. unto 100, and thereunto is adjoyned the degrees of the *Meridian inlarged* and numbred thus, 10,20,30.unto 70. each degree both in the *Equator*, and *Meridian*, are divided into parts, and theſe two graduated *Circles* ſerve to reſolve ſuch *Queſtions*, which concerne *Latitude, Longitude*, Roumbe, *and diſtance in Nauticall operations*.

Sixtly, to the concave of the *Ring* may be added a *Circle* to be elevated, or depreſſed for any *Latitude*, repreſenting the *Æquator*, and ſo divided into houres and parts with an *Axis*, to ſhew both the houre, and *Azimuth*, and within this *Circle* may be hanged a *Box* and *Needle*, with a *ſocket* for a *ſtaffe* to ſlide into it, and this accommodated with ſcrew pinnes, to faſten it to the *Ring*, and *Staffe*, or to take it off at pleaſure: Thus for the firſt way of inſerting of the Projection, on the face and backſide of the *Ring*, a ſecond way followeth.

2. *How the Projection may be formed in a Ring, ſo that all the graduations may be upon one ſide onely.*

THis may be done by a double projection, if the mooveable *Circle* be ſo fitted that it moove upon a Plate, and be of ſufficient breadth to containe all the *Circles* of the ſingle projection, and that one of the *fixed Circles* retaine the ſame breadth with the mooveable: as for the innermoſt *fixed Circle*, that may be but as an edge onely, then may there be a ſmall channell in the innermoſt *fixed Circle*, in which may be placed a ſmall ſingle Index, which may have ſufficient length to reach from the innermoſt edge of *the Mooveable Circle*, unto the outmoſt edge of the *fixed Circle*, which may be mooved to and fro at pleaſure, in the Channell, which Index may ſerve to ſhew the oppoſition of *Numbers*; then upon the other ſide of the *Ring* may be placed what the fancie may allude unto.

3. *How to fit the Circles of the Ring by a ſingle Projection into a Ring, ſo that all the Circles may be upon one ſide onely.*

THis is done by having a narrow *Circle* turned, to moove about the outward edge of a broad *Circle*, ſo that being framed together, it may to the eye ſeeme but as one *Circle* onely, then may all the *Circles* of the *Projection* be deſcribed and graduated on the broad *Circle*, and to the narrow *mooveable Circles* may bee placed two like edges of Mettle as the parts of a double *Index*, which may extend unto the largeneſſe of the *broad Circle*, which may move ſomewhat ſtraight in a Chanell made in the narrow Circle, for then theſe edges being placed unto any two *proportionalls* in the Projection, if you ſhall alſo moove that *Circle* which carries theſe two edges; as the one edge paſſeth by any Number in that *projection*, the other will ſhew the fourth *proportionall*, in the ſame projection, and this way doth avoyd the mooving of an Index at the *Center*; for that is ſupplyed by the motion of the *Peripheria* of the *Circle*, and ſo according to this direction you may retaine the forme of a *Ring*, and have all the Circles to the eye upon one of the ſides of the *Ring* onely; which forme is more *Gentile*, and *Mathematicall*, then if the projection were placed on a *Plate* or *Plaine*; Many other formes might be deliverd, about this ſingle *projection*, but theſe may ſerve for the preſent.

Of the enlarging, or augmenting, of the Projection of the Circles of the Mathematical Ring, to worke accuratly Trigonometrie.

THis augmentation of the projection is very facil, being but onely the *doubling, tripling, quadrupling, quintupling, decupling, centupling* of *Circles* in the ſingle projection, and ſo to conceive ſuch *decuplation, centuplation*, &c. onely to be the parts of one of the ſingle *Circles*, and may be divided and graduated out of the former *Tables of Logarythmes*, as though theſe *Circles* were onely one continued *Circle*, and the way how, we will ſomewhat open by this generall *Rule*, Divide 10000. (which is the *Radix* of numbers) *by that number which you intend to have the projection enlarged upon, according to a Ratio, or proportion aſſigned, and the Quotient ſhall ſhew the number of parts that one ſingle Circle ſhall be divided into*; which *Circle* ſo divided is the ground of the whole *projection*. As for example, admit the *Ratio*, or proportion of the augmented projection were required to bee *Quadruple* to that which is ſingle, that is, foure times greater, then, having deſcribed foure *Quadruplicities* of *Circles*, according to the Scheme *B*, and one ſingle *Circle* noted with *E*, divide the ſaid 100000. by 4. the *Quotient* is 25000. which ſignifieth that the outmoſt Circle *E*, (being the $\frac{1}{4}$ part of each *Quadruplicitie* of the other foure Circles) muſt bee divided into 25000. equall parts, therefore let it firſt bee divided into 25. equall parts, each of thoſe parts divided into halfes, and every one of them divided into 5. parts, ſo the whole Circle ſhall be divided into 250. equall parts, then may each of thoſe diviſions bee divided againe into halfes, and every one of theſe halfes may bee divided alſo into 5. other equall parts, and then the whole Circle ſhall be divided into 2500. parts, and if the diviſions be great enough, let every one of them bee divided againe into 10. other equall parts, ſo the whole *Circle* ſhall bee divided into 25000. equall parts; if they cannot bee divided into ſo many parts, yet wee may conceive them ſo to be divided; and ſo of other diviſions for this projection, which Circle of equall parts may be noted at each capital diviſion thus, 1, 2, 3, 4, 5, 6, &c. unto 25.

How to divide the projection inlarged.

Now to graduate theſe quadruplicities of *Circles* from the ſaid *Circle of equall parts*, you ought to keepe the ſame method that was uſed in the dividing of the ſingle *Circles* in the ſingle projection, onely this by the way ought to be obſerved, that when you have divided one revolution and come to *the line of conjunction*, the tabular numbers will exceed the *Radix* of the *Circle*, viz. the former 25, and Ciphers, and then how much the tabular number is above it, account beyond *the line of conjunction*: ſo to graduate 17. upon *the Circle of numbers* which falls not beyond the line of Conjunction ſeeke the *Logarythme* of the ſaid 17. which is 123044. (the *Index* 1. being rejected) account from E, in the *Circle* of equall parts in the ſcheme *B*, onely 23044. and laying a Ruler upon it and the *Center*, interſect the lowermoſt *Circle* of the former, which belongs to the projection of numbers in 17. but if 18. were to bee inſerted into the projection, ſeeke for it in the Table, ſo right againſt it is 125527. account beyond *the line of conjunction* onely the 25527. and lay a *Ruler* upon it and the Center, and interſect the next higher *Circle* in 18. moreover, to note out 19. upon the ſame *Circle*, againſt which in the *Table of Logarythmes* is 27875. Now becauſe the *Radix* as before is but 25. and ſeeing 27. in this number exceeds it by 2. reckon that 2. for 27. and account from 2. in the Circle of equall parts, the other part of the number, viz. 875. and lay a *Ruler* thereto, and to the *Center*, and interſect the former *Circle* in 19. and ſo proceede for the dividing of the other numbers untill you come to *the line of conjunction*; then will the *Radix* be there 50. becauſe of two revolutions, therefore at the figure of 1. beyond *the line of conjunction*, you may account it 51. at the figure of 2. account it 52,&c. and comming to the line of Conjunction let the 25. be accounted 75. becauſe of three revolutions, then at the next 1.account it as 76.at the figure of 2. account it as 77. and ſo proceede untill you come to the firſt *Radix*,viz. 100000. or to *the line of Conjnnction* at the point *E*.this being fully conceaved, and having a ſcheme here already graduated, it ſhall be eaſie from this to divide any other projection which is to bee augmented in a different manner : But if the projection inlarged bee of a *Decuple*, or *Centuple* proportion, then the outmoſt *Circle* is to be divided onely into 10000. equall parts according to the Circle of equall parts *E. in the ſingle projection*, and then the *Logarythmes* in the *Table* will divide them without any conſideration (the Index being onely reiected) and as *the whole Circle of Numbers* in its quadruplicities of Circles may bee divided by the former directions, ſo in like manner *the circle of Sines*,and *Tangents*,in their quadruplicities of Circles may alſo be divided : and ſo of any proiection in this kinde. Thus for the augmenting of the Circles of the proiection of my *Mathematical Ring*, and of the dividing of them.

Of ſeverall wayes how the Circles of the Mathematicall Ring (being inlarged) may be accommodated for Practicall uſe.

FIrſt the *Circles* being proiected ſingly upon a *Plaine*, an *Index* with two feete or a flat *Compaſſes* may bee placed at the Center to open at any two tearmes aſſigned : and ſo to move it about as occaſion requires, but in ſtead of it a *ſemicircle* may be faſtned there, and a *ſingle Index* to move upon it, ſo that the *Radius*,or edge of the *ſemicircle* being placed to any one number, the *Index* may be placed to the other number : and then if the *ſemicircle* be mooved *Circular*,as the *Radius* of the *ſemicircle* paſſeth by any number in the proiection, ſo the edge of the *Index* in motion ſhall ſhevv the proportionalls in that projection; or a paper edge, and a *thread*, with a *beade* may bee ſufficient, ſeeing the *Circle of equall parts* will ſhevv the equall diſtances of the proportionalls, &c. But the way of operation upon this ſingle proiection with an *Index, &c.* to a learner will bee ſomewhat troubleſome for the ſeverall obſervations that neceſſarily depend upon that way, and cannot bee avoyded, But a double projection makes it very facil.

2. *A ſecond way of accommodating this inlarged Logarythmall Projection, for practicall uſe, with a ſingle Index onely.*

THis is done by having a double *Projection* inlarged on a *Plaine*, the one to be fixed and the other to be moveable, (agreeable to the ſcheme *A*, in the title page) for being ſo fitted it ſhall operate with the ſame facilitie and expedition, as though it were a ſingle *Projection*, the proportionall numbers being alwayes by oppoſition, & in like differences of *Circles*, one caution conſidered; and the *Index* at the *Center*, is onely but to helpe the eye in finding them.

3. *A third way of fitting of the Circles of the Projection for Practicall uſe.*

THis is performed by helpe of a double proiection, the one to be fixed, and the other to bee mooveable: But ſo that the Circles of the mooveable being deſcribed, every other Circle may bee cut out, that is, that there may bee a vacuitie betweene each *Circle*, then let the edge of the *mooveable Circle*, be divided and graduated anſwerable unto the graduation and diviſions of the proiection on the fixed, but ſo that the whole *mooveable Circle* being placed at the *Center*, the diviſions, graduations, and figures on the ſaid fixed *Circle*, may be ſeene conſpicuous through theſe Channells, and vacuities which are cut out in the mooveable, ſo this *Projection* ſhall allſo ſhew, or give the proportionalls by oppoſition, as the former.

4. *A fourth way, how the Logarythmall projection of my Ring inlarged, may be fitted in an inſtrumentall forme for practicall uſe in Calculation.*

This may bee done according to my great *Cylinder* which I have long propoſed (in which all the Circles are of equall greatneſſe,) and it may be made of any magnitude or capacity, but for a ſtudy (hee that will be at the charge) it may be of a yard diameter and of ſuch an indifferent length that it may containe 100. or more Circles fixed parallell one to the other on the *Cylinder*, having a ſpace betweene each of them, ſo that there may bee as many mooveable Circles, as there are fixed ones, and theſe of the mooveable linked, or faſtned together, ſo that they may all moove together by the fixed ones in theſe ſpaces, whoſe edges both of the fixed, and mooveable being graduated by helpe of a ſingle Index will ſhew the proportionalls by oppoſition in this double *Projection*, or by a double *Index* in a ſingle *Projection*.

Of the deſcription of the Grammelogia or the Circles of my Mathematicall Ring on a Plaine, according to the diagramme that was given the King (for a view of that projection) and afterwards the Ring it ſelfe.

The parts of the *Inſtrument* are two *Circles* the one mooveable and the other fixed, the mooveable *Circle* is that unto which is faſtned a ſmall pin to moove it by, the other Circle may bee conceived to bee fixed; upon the mooveable and fixedthere are deſcribed thirteene diſtinct *Circles*,nowithſtanding, on the mooveable and fixed there are 24.ſeveral *Circles* conſiderable, of which there are foure in the mooveable,anſwerable to foure in the fixed, which double *Circles* are divided & noted with letters both in the mooveable and fixed,as followeth.

The Circles of the fixed are noted with theſe letters,viz.
- ♋. *The Circle of degrees and Calender.*
- E. Repreſents the *Circle of equall parts,* and part of the *Equator,*& *Meridian.*
- *T* *T* *The Circle of Tangents.*
- *S. The Circle of Sines.*
- *D. The Circle of Decimals.*
- *N. The Circle of numbers.*

The Circles on the mooveable are noted with theſe letters, viz.
- *N. The Circle of Numbers.*
- E.*The Circle of equated figurs,& bodies.*
- *S. The Circle of Sines.*
- *T* *T* *The Circle of Tangents.*
- *Y. The Circle of time, yeares, and monethes.*

A more particular deſcription of each Circle, and firſt of the Circle of equall parts.

F*Irſt, the Circle of equall parts on the fixed,* is that which is next to the *Circle* of degrees, and noted with the letter E. and is figured thus, 10,20,30,40,50,60, 70,80,90,100. which figures doe ſtand for themſelves,or ſuch numbers unto which a *Cypher*,or *Cyphers* may be conceived to be added, or taken away : ſo 10.ſtands for 1. or 10. 100. 1000.&c. and ſo of the reſt, and here note that the ſpace betweene any two figures,muſt bee conceived to comprehend the difference in denomination betweene them, that is, ſo much as one number is greater than another, ſo many diviſions muſt be contained betweene theſe numbers, ſo if the 20. ſtands for 20. the 30. then ſhall ſtand for 30. and becauſe the 30. doth exceede the 20. in its denomination by ten, there muſt therefore bee conceived to be 10. diviſions betweene the ſaid 20. and 30. but if the 20. had ſtood for 200. and the 30. for 300. then the diſtance betweene 20. and 30. muſt bee conceived to containe 100. diviſions, and ſo of the reſt : which *Circle of equall parts*, in its diviſions repreſents ſuch numbers as one hath occaſion to uſe, and is of ſpeciall and ſingular uſe if it were particularly applyed, (though ſome one ſaid upon the deſcription of it, *it was ſcarce of any uſe, but onely that by helpe thereof the given diſtances of number may be multiplyed, or divided as neede requires)* had I the way made for me, and the ſubject *unvayled* to helpe my *ſight*, I ſhould ſee its uſe better then now I doe, & would not conceat my ſelfe to be ſo *ſharpe ſighted*, but bee thankeſull to any one that would *unvaile* it for me yet (acording to my weak *ſight*) had I time, and place I could not ſlober over ſuch a point, but take up much of both, to dilate my ſelfe in the ample declaration of the uſes of that *Circle*; howſoever I have ſaid ſomethings in its uſe, to illuſtrate it, and to prove my aſſertion.

Of the Equator, and Meridian.

SEcondly, the *Circle of equall parts* doth not onely repreſent it ſelfe, but alſo a part of the *Equator*, or *Equinoctiall Circle*, containing 100. equall degrees, each degree being divided actually into 10. parts, ſo that each part doth containe 6. minuts, and is numbred as before at every tenth degree, thus, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100. upon the inner ſide of which *Circle* are graduated the degrees of the *Meridian* inlarged, or the unequall degrees of Latitude according to Wrights projection, figured & noted thus, 5. 10. 15. 20. 25, &c. unto 70. gr. each degree being divided into 10. parts, ſo that each part containeth 6. minuts alſo as before, which diviſions may be called the *Meridian Circle*, or the *Circle of Latitudes*.

Of the Circle of time.

THirdly, the innermoſt *Circle* on the mooveable which is noted with the letter *T*. figured thus 1, 2, 3, 4, &c. unto

30.

30.and eachof the ſpaces is ſubdivided into 12. equall parts and is called *the Circle of time*,or *yeares*, the ſpaces noted with figures being *yeares*,and the ſubdiviſions,*moneths*,and ſerves for to operate ſuch queſtions as concernes intereſt and valuation of Leaſes,but the outmoſt *Circle*, which is noted with letters upon the inner ſide, is the *Calender* of time,divided into moneths & daies; and is adjoyned to the degrees of a *Circle*, noted with the Signes that ſo readily knowing the day of the moneth, the *Suns* place may bee found,and ſo contrarily;which *Circle* of degrees ſerves alſo to take the *Sunnes* higth,and for the obſervation of *Angles*.

Of the Circle of Tangents.

FOurthly, the next *Circles* to that of equall parts on the fixed are the two *Circles* noted with *T T*. which are but one *Circle* in effect, and is called the *Circle of Tangents*, which comprehends neare a *Quadrant* or 90.gr.and is graduated and numbred on both ſides, having its beginning at the *line of conjunction* E N, at 34.m.22.ſ.the numbers that are minuts are noted with a touch over them thus, 35' that ſo they may bee diſtinguiſhed from theſe numbers which are degrees that are not noted at all. So the *Circle of Tangents* which is next to the Circle of equall parts is figured upon the outward part of it, in its diviſions from 35.m.unto 5.gr.32.m.48.ſ. and the degrees are noted ſomewhat greater then the reſt thus, 1, 2, 3, 4, 5. In the next undermoſt Circle theſe degrees from the ſaid 5. are continued and are noted upon the outſide of the ſame *Circle*, from 6.gr.unto 45.gr.which 45.gr. are continued upon the inner ſide of the ſame *Circle* unto 84.gr.17.m.21.ſ. and theſe are further continued on the inner ſide of the uppermoſt *Circle* unto 89,gr.24.m.38.ſ. Theſe two *Circles* are called the *Circle of Tangents*;And the *Circle of Tangents* noted in like manner with *T T*, in the mooveable,is the ſame with this *Circle of Tangents* on the fixed : every degree in each of which *Circles* unto 10.gr.is divided actually into 60.diviſions, each of which repreſents one minut, and from 10.gr.unto 80.gr.every degree is divided into 30. diviſions,

viſions,each diviſion being 2. minuts then from 80. degrees unto 89 gr. every degree is divided into 60. parts or minutes as before: This for the deſcription of the *Circle* of *Tangents*, both on the *fixed* and *moveable*.

Of the Circle of Sines.

Fiftly, next unto the *Circle of Tangent*, is the *Circle* of *Sines* noted with the letter *S*. as before, having its beginning at the *line of Conjunction* at 34.m.22.ſ.and is figured and divided upon both ſides, upon the inner ſide it is numbred from 25. m. unto 5.gr. 44. m. 21.ſ. which are almoſt oppoſite to the like degrees in the *Circle of Tangents*, which degrees are continued upon the outward ſide of the ſame *Circle* unto 90.gr.and are numbred thus, 6.7.8.9.10. &c. unto 90. every degree in this *Circle of ſines* is divided into parts according to the greatneſſe of degree, and the *Circle of ſines* on the moveable is the ſame with this on the fixed.

Of the Circle of Decimalls of money.

Sixtly, next unto the *Circle of ſines*; on the fixed, is the *Circle* of the *Decimals* of money, noted with the Letter *D*. and is divided on the innerſide, and figured thus, 1.2.3.4.5.&c.unto 23.and each ſpace ſubdivided into 4. parts: which diviſions ſo numbred are the *decimals* of pence, (or the diviſions or notes of the whole *Circle*) & are to be conceived to be the $\frac{1}{10}$ of a pound of money. In like manner the ſaid *Circle* is farther divided on the outer ſide, and figured thus, 1.2.3.4.5.&c.into 19 parts & the ſpaces betweene each figure is divided into 12.parts, (or as many parts as each ſpace will containe) which whole *Circle* ſo divided (is ſuppoſed to repreſent *a pound of money*,) is the *Decimall of ſhillings*, or of *a pound of money*: the like may be done for the *Decimals of waight*.

Of the Circle of Equated figures, and Bodies.

S*eventhly*, the *Circle* which is alike ſituated unto this on the moveable that is noted with the letter *E*. is the *Circle* of equated *figures* and *Bodies*, ſerving excellently to facilitate and expedite ſuch operations which concerne regular *figures*, and the five *platonicall Bodies*, with other occurrents, a touch upon which was ſhowne in the *Epiſtle*: But more at large in its place is ſpecified: which *Circle* of equated *figures* and *Bodies*, is divided out of this *Table* enſuing, as the *Circle* of *numbers* was out of the *Table* of *Logarythmes* wch containes 100.notes, 50.of them ſerving for *Superficies*, and the other 50, for *Solids*.

Tabula notarum corporum ſolidorum & figurarum regularium.

Notæ figurarum.

Hep.m.	01639	Hex.	41465
De. e.	05692	7.	42254
Hep.cir.	06159	8.	45154
Cir. e.	07954	Tri. in.	46040
Oc. in.	08174	9.	47712
P. 18.	09151	Qu.e.10	50000
No, e.	10444	Cir e.	55245
Oc.cir.	11613	Hep.	56046
No. in.	13790	Tri.	63650
2.	15051	Tri. e.	68175
Oc. e.	15809	Oc.	68380
F B.	15836	Qu.in.	69897
No.cir.	16491	M. ac.	75867
P. 16 $\frac{1}{2}$	16749	Tri. cir.	76143
De. in	18719	No.	79111
A. c.	20411	Pen. in.	83770
De. cir.	20898	Qu. cir.	84948
Hep. e	21976	De.	88616
Pen.	23565	Cir. D.	89509
3.	23856	Pen.cir.	92975
Hex. e.	29267	Hex. in.	93753
4.	30103	P. 21.	95762
5.	34948	P. 20.	100000
Pen. e.	38217	♃. C.s.	100000
6.	38907		

Notæ Solidorum.

D.cir.	04669	O. cir	38907
T. S.	07133	Cil. $^{c}_{,}$	42542
T.in.	08804	D. in.	44754
2.	10034	Cyl.G	46852
I. cir.	12161	S. x.	49714
S. in.	15051	O. x.	53959
3.	15904	I. e.	55340
Cyl. $^{c}_{f}$	16837	☉	59050
4	20068	f. t	61876
5.	23300	C e.	66666
Gag.	23426	Cyl. $^{D}_{f}$	67117
F. T.	23754	O s	67339
T. x.	23856	T.cir.	69010
C. in.	23856	S. s.	71899
Gag.A	24349	☿.	73663
6.	25938	S. e.	76033
I. in.	27923	O. e.	77553
7.	28170	C. x.	77815
C.cir.8	30103	♄.	80855
D. x.	31483	☾.	85497
9.	31808	D. s.	88440
10.	33333	♀.	91497
I. s.	33879	I. x.	93753
Cil. $^{d}_{f}$	34245	♂	96614
D. e.	37186	T. e.	97612

A deſcription of theſe Tabular notes.

Theſe notes do repreſent the

Regular figures.

	ſtands for
Cir.	Circle.
Tri.	Triangle
Qu.	Square
Pen.	Pentagō
Hex.	Hexagon
Hep.	Heptagon
No.	Nonogon
De.	Decagou

theſe letters joyned with the former, as

	ſignifie
e.	equall.
in	inſcribed.
c.	circūſcribed.

Regular Solids.

	ſtands for
T.	Tetraedron.
O.	Octaedron.
C.	Hexaedron.
D	Dodecaedron
I.	Icoſaedron.
S.	Spheare.

theſe adjoyned,

	ſignifie
s.	ſolidity.
e.	equall.
x.	convexity
in.	inſcribed.
cir.	circumſcribed.

These notes,

These notes	represent
P.16.½	feete to a Pole.
P.18.	
P.20.	
P.21.	
Ac.	Acres:
F.B.	Foote of Board.
F.T.	Foote of Timber.
f. t.	Foote of Timber equated.
Cir.D.	Circles Diameter.
Cir.c.	Circles Circumference.
Cyl. ${}^{D}_{s}$	Cylindricall ſoliditie.
Cyl. ${}^{c}_{s}$	
Cyl. ${}^{d}_{f}$	Cylindricall foote meaſure.
Cyl. ${}^{c}_{f}$	
Gag.	Gage for wine.
Gag. A	Gage for ale.

these notes repreſent metals, viz.

	ſtands for
☉	Gold.
☽	Silver.
☿	Quikſi.
♀	Copper.
♃	Tinne.
♄	Lead.
♂	Iron.

Of the Circle of Numbers.

Eightly, the Circle next to the *decimals* of money, noted with the letter *N* on the fixed is the *Circle of Numbers*, and is divided into unequall parts, charactered with figures thus, 1.2.3.4.5.6.7.8.9. theſe figures do repreſent themſelves or ſuch numbers unto which a *Cypher* or *Cyphers* are added, and are varied as the occaſion falls out in ſpeech of numbers.

Firſt, if the figure of 1. ſtands but for 1. then all the diviſions in the *Circle* by *deminition* are the parts of 1. ſo the figure of 4. ſtands for the fourth part of 1. (if 1. be divided into 10. parts,) or the 4. ſtands for 40. parts of 1. (if 1. be divided into 100. parts,) 8. ſtands for eighth part of 1. &c. but if 1. ſtands for 1. by augmentation, then the figure of 2. ſhall repreſent two, the figure of 3. ſhall ſtand for three, &c. and the ſpace betweene each figure ſhall be the parts of 1.

Secondly, if the figure of 1. ſtands for 10, then the figure of 2. ſtands for 20. the figure of 3. for 30 &c. hence it followeth that betweene the figure of 1. and the figure of 2. or betweene 2. and 3. muſt be 10. diviſions to repreſent the intermediate *numbers*, the middle of thoſe diviſions is noted thus ·|· as if the 2. be 20, and the 3. be 30. then at the next great diviſion you may account 21. two diviſions beyond the figure of 2. to be 22. at the next great diviſion you may account 23. and ſo on, *numbring* till you come to 30. or any other number, which diviſions noted thus ·|· is onely to helpe the eye in *numbring*.

Thirdly,

Thirdly, if the figure of 2. ſtand for 200 then the figure of 3. is 300 the figure of 4. is 400. hence there muſt be 100. betweene 200. and 300. and 100 more betweene 300. and 400. and ſo of others. Now ſeeing that *ten tens* make an *hundred*, there muſt be 10. diviſions betweene the ſaid 200. and 300. and every one of thoſe diviſions do repreſent 10. ſo the ſaid note .|. ſhall be halfe of the ſaid 100. therefore at that note you may read 250. and the middle betweene 300. and 400. viz. at .|. reade 350. &c.

Every one of the diviſions which ſtand for 10. is divided againe into 10 other diviſions, the middle of which hath its diviſion a litle higher than the reſt, to helpe the *eye* to *number* more readily.

☞ *And* here generally is to be noted, that what *denomination* you give unto any of the figures, the next great diviſion is the next *ſubdenomination*, and the next leſſer diviſion to that greater is the ſecond *ſubdenomination*, as if I ſhould ſpeake 243. here the *denominations* are *Hundreds*, *Tens*, and *Unites*: therefore the figure of 2, ſhall ſtand for 200. the foure great diviſions next the 2. ſhall be 40. and the next three ſmall diviſions ſhall repreſent 3. (which is within ſeaven ſmall diviſions of .|.) and ſo of others.

Thus for the deſcription and *numbring* upon the *Circle of numbers* on the *fixed*. The *numbers* & diviſions on the *moveable Circle*, are the very ſame with that on the *fixed*; for if you move 1. in the *moveable* to 1. in the *fixed*, there is repreſented to every *number* or diviſion his oppoſite, not onely in the *Circle* of *numbers*, but alſo in the *Circle* of *Sines*, and *Tangents*.

And thus in theſe two *Circles* of *numbers*, and in the other *Circles*, there is a great body of *numbers*, the one ſtanding alwayes *fixed*, and the other to be *moved*; and if any *number* in the moveable be moved, all other *numbers* move with it: ſo if you move 25. in the moveable in the *Circle of numbers*, unto 30. in the fixed on the *Circle of numbers*, right againſt 26. in the *moveable*, is 31. and 2. tenths in the *fixed*, and right againſt 27 in the *moveable*, is 32. and 4. tenths in the *fixed*, right againſt 30. in the *moveable* is 36. in the *fixed*, againſt 46. in the *moveable*, is 55. and 2. tenths in the *fixed*.

Againe, if 108. in the *moveable* be brought to 15. in the *fixed*, right againſt 16. in the *fixed* is 115. in the *moveable*, and right againſt 12. in the *fixed*, is 86. and 4. tenths in the *moveable*.

Thus what *denomination* you give unto the numbers in the Circle of numbers in the *moveable*, you are ſucceſſively to keepe the ſame *denomination*, and the like is to be conceived touching the progreſſive denomination of *numbers*, in the *Circle* of *numbers* in the *fixed*. Thus for the deſcription of the *Inſtrument*, the uſe followeth.

How to performe the Golden Rule, or to finde a Proportionall Number unto another Number, as two other Numbers are in proportion amongſt themſelves.

This Rule of all other is the moſt excellent and the moſt generall, as well in *Mathematicall* Calculations, as in Arithmeticall Computations, and therefore may not unfitly be ſo called, and the *Inſtrumentall* operation is rather more facile in this Rule, than in *Multiplication* or *Diviſion*; hence it is that I have diſpoſed it in the front of the worke, becauſe of expedition and facility: and the way of operation is thus:

Conſtructio. Seeke the firſt number in the moveable, and bring it to the ſecond number in the fixed, ſo right againſt ahe third number in the moveable, is the anſwer in the fixed.

Example 1. If the Intereſt of 100. li. be 8. li. in the yeare, what is the Intereſt of 65. li. for the ſame time.

Conſtructio. Bring 100. in the moveable to 8. in the fixed, ſo right againſt 65. in the moveable is 5. $\frac{2}{10}$ in the fixed, and ſo much is the Intereſt of 65. li. for a yeare at 8. li. for 100. li. *per annum.*

☞ The *Inſtrument* not removed, you may at one inſtant right againſt any ſumme of money in the moveable, ſee the Intereſt thereof in the fixed: the reaſon of this is from the *Definition of Logarithmes.*

Definitio. *Proportionales Logarithmi æquales habent differentias.*
Neceſſe eſt igitur proportionales Logarithmos in proportione Lineari diſtantias æquales habere.

If

Example 2. *If a Troope of 50. Horſe have for their pay 140. li. how much ſhall ſuffice to pay a Troope of 64. Horſe.*

Conſtructio. BRing 50. to 140 then right againſt 64. in the moveable is, 179.2. in the fixed, the monthly pay of the ſaid 64. horſe. And there immediatly may you ſee the monthly charge of any number of Horſe, for, the number of Horſe given in the moveable, right againſt it, is their pay in the fixed.

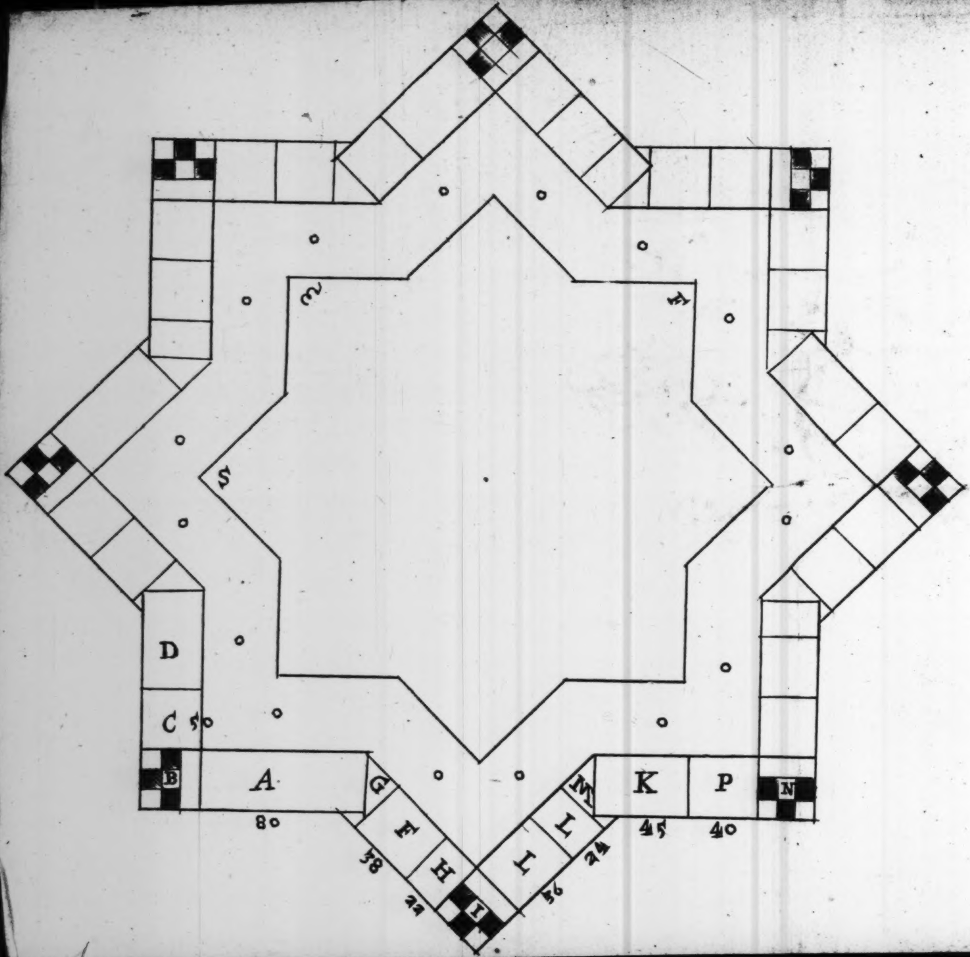
Example 3. *It is ſaid that the proportion betweene the circumference of a Circle to his Diameter is 7. to 22.*

Bring therefore 7. in the moveable to 22. in the fixed, then immediatly at one inſtant may you have the *Diameter* or *Circumference* of any Circle, only by an ocular inſpection: for right againſt the *Diameter* in the moveable, is the *Circumference* in the fixed; or right againſt any *Circumference* in the fixed, is his *Diameter* in the moveable: Thus for the ſimple Rule.

Further uſes of the Golden Rule in ordinary ſervice in proportionating of things.

Example 4. Let *FLX.* repreſent the *Perimeter* of a Pentagonall Fort, and let the diſtance betweene the points of the Baſtines, *FL.* be 926. foot, or *KL* the ſquare ſide of a Building 470. foot, and the other dimentions, both of the Fort, and the Building according to the here under inſcribed Tables.

The diſtance betweene the points of the Bulwarke.	*F L.* 926.
A perpendicular	*C R.* 617.
The Cortine	*A B* 652.
The ſide of the Fort	*D N* 425.
The gorge line	*A D.* 119.
The Flanke	*D E.* 100.
The line of defence	*D L.* 700.
The face of the Baſtine	*E F.* 264.
The capitall line	*A F.* 224.
The diſtance from the Center to the Baſtine	*A C.* 554.
From the Cortine to the Center	*C I.* 456.
The bredth of the Bulwark.	*G E.* 310.


S
D
C
50
B
A
80
G
F
H
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38
22
M
L
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36
24
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45
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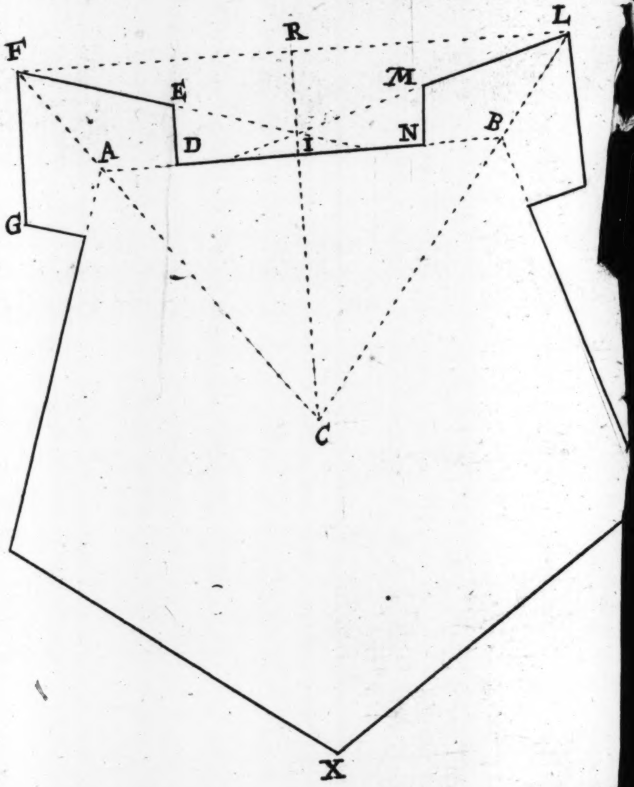
F
R
L
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X

The greateſt ſquare ſide of the Building——KL.470. foot

Q A court within the middle of the Building.

The diſtance betweene the middle of the Court and any out angle, as——————— } K A. 236.

The leaſt inner ſquare of the Court————E F. 200.

Betweene any out corner of the Building, as— RX. 180.

o. o. o. &c. a ſtone Gallery in bredth ——— 36.

And ſo of other under roomes to other uſes.

NOw admit another like *Fort*, or another like *Building* is to be erected, whoſe greateſt diſtance betweene the aforeſaid points of the Baſtines, can be but 750. foot, or the greateſt ſide of the peece of ground where the *Building* is to bee made, is but 400. foot, what ſhall the ſeverall meaſures of this new *Structure* be, ſo that the *Fort* to the *Fort*, or the *Building* to the *Building*, in all parts be proportionall?

This is performed with much facility and expedition by this *Grammelogia*. *Conſtructio.*

For if you move the whole to the whole, *viz*. 926. to 750. or 470. to 400. right againſt the ſeverall knowne meaſures in the moveable, you have the ſeverall required meaſures in the fixed. I bring therefore 926. unto 750.

So right againſt

In the moveable is	In the fixed
637	515. 9.
662	536. 1.
425	344. 2.
119	96. 4.
100	81. 0.
700	566. 9.
264	213. 8.
224	181. 4.
564	456. 8.
456	369. 3.
310	251. 1.

So right againſt

in the moveable is	in the fixed,
236	285. 9.
200	170. 2.
180	153. 1.
36	27. 8.

Theſe numbers found out by the ordinary way of Arithmeticke may trouble a nimble Arithmetician a whole houre or more, and therein ſubject to much error, but others 6. or 8. houres at the leaſt, if not more; but by this *Grammelogia*, they are found out in leſſe time than halfe a quarter of an houre: for ſo quicke is its operation in any *queſtion*, to him that hath the way of working by it, that it gives the *Anſwer* before a man can diſtinctly write downe the numbers propoſed in the *queſtion*.

Further uſes of the Golden Rule, in matters of combination of Numbers, how to part a number into parts, as another number is already parted.

1 LEt *A.B.C.D.E.* be five men which adventure money in a *Plantation* or otherwiſe: *A.* adventures 84. li. *B* 72. li. *C* 48. li. *D.* 54. *E* 42. li. by which in the returne is gotten 50. li. how much ſhall *A. B. C. D.* and *E.* have, according to their ſeverall disburſments.

2 Or admit *F.* borroweth of *A.* 84. li. of *B.* 72. li. of *C.* 48. li. of *D.* 54. li. and of *E.* 42. li. *F.* dies, and his whole eſtate is worth but 50. li. how much ſhall every Creditor have of this 50. li. according to his money lent.

3 Or ſuppoſe *A. B. C. D. E.* were five ſeverall metals, alotted to make a Statue, Veſſell, Bell, &c. *A* Gold, *B* Silver, *C* Coper, *D* Latten, and *E* Tin; now when the Metals were melt and caſt, there was left a peece which weighed 50. li. how much Gold, Silver, Coper, Latten, and Tin doth it containe, that ſo the worth of that peece may be knowne.

4 Or if there were 5. *Companies*, or 5. *Captaines*, *A. B. C. D. E.* who expect their Pay, to *A* was owing for his ſervice 84. li. to *B.* 72. li. to *C.* 48. li. to *D.* 54. li. and to *E.* 42. li. Now to keepe them from mutiny, the Generall ſends them 50. li. to be parted amongſt them proportionally according to each others dues, what ſhall *A. B. C. D. E.* have?

5 Or admit *A. B. C. D.* and *E.* ſhould load a ſhip of 300. tuns, *A* layes in 84 tuns, *B.* 72. *C.* 48. *D.* 54. and *E.* 42. tuns; in the voyage by reaſon of tempeſt, for ſafegard of their lives and Ship, there was caſt over boord 50. tuns of the loading, how much ſhall *A* beare of the loſſe, as alſo *B. C. D.* and *E.*

6 Further, in a Shire there is to be raiſed of 5. men, *A. B. C. D.* and *E.* 50. li. proportionally according to their eſtates; *A* is worth yearely 84. li. *B.* 72. li. *C.* 48 li. *D.* 54. li. and *E.* 42. li. how much ſhall each one pay, &c.

THus I might infinitely dilate my ſelfe upon one ſubject, tending to admirable uſes, I onely in this glance by things, making but way to the occaſions: The reſolution of which, and all others of this kinde, is drawne from this enſuing Axiome.

Axiome.

There is ſuch proportion betweene any whole, and his parts, as betweene the like whole, either greater or leſſer, and his parts: or betweene the parts and the parts, as betweene the whole and the whole.

Declaratio.

So in the firſt example, Adde the money of *A. B, C. D.* and *E.* together makes 300. li. this is the whole, the parts are the former: now 50. li. is another whole number, which muſt be broken into parts proportionall to the former; and this differeth nothing in the operation from that of the laſt, in proportionating the Fort to the Fort, or the Building to the Building: for ſuch proportion as 300 li, the whole money diſburſed hath unto 50. li. the whole money gotten, ſo ſhall *A* 84. have to his part, and ſo of any other.

Conſtructio.

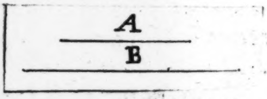
Bring therefore 300. in the moveable unto 50. in the fixed, ſo right againſt any particular part in the moveable is his part proportionall in the fixed, as there apparantly is ſeene, and from thence they are taken and placed in a Table, as here under appeares.

As 300. to 50. ſo	A. 84.	to	14.
	B. 72.		12.
	C. 48.		8.
	D. 54.		9.
	E. 42.		7.

More uſes upon the Golden Rule, in the diviſion of Lines.

Propoſitio.1. TO *finde a Line that ſhall keepe any proportion aſſigned unto another line given.*

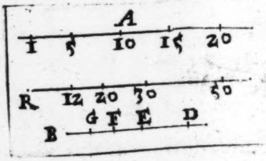
Declaratio. As, let a Line be found which ſhall keepe proportion to the line *A.* as 3. to 5.



Conſtructio. Meaſure the line *A* by a ſcale of equall parts, then bring 3. unto 5. ſo againſt the meaſure of the line *A* in the moveable, you have the meaſure of the line required in the fixed, *viz.B*. ſo the lines *A* and *B* are in proportion as 3. to 5. &c.

Propoſitio.2. *To divide a Line into any number of equall parts.*

Declaratio. Let it be required to divide the Line *A* into 23. parts: firſt,



Conſtructio. by a ſcale of equall parts meaſure the Line *A*, which admit to bee 51. parts, bring then 23. in the moveable unto 51. in the fixed. So right againſt 1. 5. 10. 15. 20. in the moveable, is 2. and 2. 10. 11. and 1. 10. 22. and 2. 10. 33. and 2. 10. 44. and 3. 10. in the fixed: if theſe numbers be taken from the ſame ſcale, and applied to the line *A*, it will be divided in the points of 1. 5. 10. 15. and 20. then may thoſe parts be eaſily ſub-divided.

Propoſitio.3. *To divide a Line in ſuch ſort or proportion as another Line is already divided.*

Declaratio. Let the Line *B. C.* bee divided in the points, *D. E. F. G.* and *H.* as the Line *R.* is divided.

Conſtructio. Meaſure the Line *R.* 58. and his diviſions *R.* 12. *R* 15 *R.* 20: *R.* 30. *R.* 50. then let *BC.* be meaſured, which admit it containe 37. parts, bring 51. unto 37. ſo againſt the parts of *R* in the moveable, you have the parts of *BC.* in the fixed, *viz.* *BD. BE. BF. BG.* and *BH.*

Propoſitio.4. To finde a line in continuall proportion unto two given lines, or a proportionall line to 3. lines, it differeth nothing from that of Numbers, and therefore wrought accordingly.

Notions,

Notions or principles touching the diſpoſing or ordering of the Numbers in the Golden Rule in their true places upon the Grammelogia, and the congruity of thoſe Numbers one unto another.

NOte that in any queſtion of the *Golden Rule*, there are three numbers to worke upon, whereof two of them are of one denomination, the one of them hath his anſwer, and the other doth require an anſwer, and thoſe two numbers of like denominations muſt be alwaies accounted or ſought out upon the moveable *Circle*. 1

As if 30. li. doe rent 45. Acres of Land yearely, how much doth the yearely Rent of 84. Acres come to. Example.

Here the denominations alike are 45. Acres and 84. Acres, 45. Acres hath his anſwer, 30. li. and 84. Acres requires his anſwer.

For the working of this and all others, Let the numbers in the moveable be brought to his anſwer in the fixed: that is, bring 45. to 30. ſo, right againſt the thing demanded in the moveable: that is, againſt 84. ſhall be the anſwer in the fixed, *viz.* 56. and ſo many pounds will rent yearely the ſaid 84. Acres.

Secondly, note further, that thoſe three numbers as 45. Acres, 30. li. and 84. Acres, are diſtinguiſhed by numerall attributes, as firſt, ſecond, and third. Hence of ſome it is called the rule of three, and the anſwer to 84. Acres is called the fourth number, which is ever of the ſame denomination that the ſecond number is of: and the *fourth number* ſought for hath alwaies ſuch proportion to the *third number*, as the *ſecond* is to the *firſt*: *Vel contra.*

From which by a more generall name, it is called *The Rule of proportion*, for that it proportionateth things unto any proportion aſſigned; ſo is the ſaid 56. a proportionall number to 84. as 30. is unto 45. for 56. is two third parts of 84. and ſo is 30. two third parts of 45.

Therefore theſe foure numbers, 45. 30. 84. 56. are proportionall numbers one unto another: ☞ *And here note generally* in direct proportion, if the *third number* be greater than the *firſt number*, the *fourth number* ſhall bee greater than the *ſecond number*.

Contrariwiſe, if the *third number* be leſſe than the *firſt number*, the *fourth number* is leſſe than the *ſecond number*.

But in *Reciprocall proportion* this fourth number is inverted; ſo if the third number be greater than the firſt, the fourth number is leſſe than the ſecond.

Example 1. *So if 45. men in 30. daies, will doe a ſervice, in how many daies ſhall 270. men doe it.*

Here the denominations alike are 45. Men and 270. Men, the anſwer to 45. men is 30. daies, the anſwer to 270. men is required.

Conſtructio. If you move 45. in the moveable to 30. in the fixed, right againſt 270. in the moveable is 180. daies in the fixed: which anſwer is abſurd, ſeeing there is more men allotted to doe the worke, there muſt moſt neceſſarily be leſſe time.

Therefore in all Queſtions of *Reciprocall proportion*, let the demand bee ſought out upon the moveable, *viz.* 270. and brought to the firſt numbers anſwer in the fixed, *viz.* 30. ſo right againſt the firſt number in the moveable, *viz.* 45. is the anſwer in the fixed, *viz.* 5. and in ſo many daies will 270. men doe that ſervice, if 45. men doe it in 30. daies.

Queſt.2. *Againe, if 3840. ſouldiers are victualed for 10. moneths, how many men may it ſerve that the ſaid proviſion may laſt 12. moneths.*

Conſtructio. In this and all others (as before) bring the third number 12. in the moveable, to the other numbers anſwer in the fixed, *viz.* 3840. ſo againſt the firſt number 10. moneths in the moveable, is 3200 men in the fixed, and ſo many men will the ſame proviſion ſerve for 12. moneths.

From which direction, thoſe enſuing queſtions, and the like, may be reſolved.

If I lend 140. *li. for* 7. *moneths, if I ſhould borrow of him* 200. *li.* *Queſt.* 3. *how long might I keepe it*; facit 4. moneths and 9. 10.

According to the Statute, if Wheat be at 50. s. *the quarter, the* *Queſt.* 4. *penny loafe ſhould weigh* 6. *ounces and a halfe, what ſhall it now weigh, if in caſe wheat be at* 3. li. 12. s. *the Quarter*; *the numbers changed into decimals will be thus, if* 2. li. 5. 10. *give* 6. *ounces,* & 5. 10. *what ſhall* 3. li 6. 10. *give* : facit 4. ounces and 5. 10.

A Gallery is found to containe in the walls 380. *yards, how many* *Queſt.* 5. *yards of Tapeſtry ſhall hang that Gallery of* 7. *quarters broad* : facit 217 yards. fere

25. *Ounces of* 7. *yards to an ounce will ſerve to lace a veſture,* *Queſt.* 6. *how many ounces of* 5. *yards to an ounce will doe the ſame, &c.* facit 35. ounces.

How to proportion a Fraction that is not Decimall, into a decimall.

So if 8. & 12. 40. were to be uſed, 12. 40. muſt be changed into a Decimall, thus: bring 40. in the moveable to 10. in the fixed, ſo right againſt 12. in the moveable is 3. in the fixed, ſo the fraction 12 40. is changed now into 3. 10. ſo for 8. & 12. 40. you have now 8. and 3. 10. which may be eaſily found out.

Againe, let 63. 84. bee a fraction which is to be uſed, this cannot be found out upon the Grammelogia: change it therefore into a Decimall.

Bring therefore 84. (the Denominator) to 100. in the fixed, ſo 63. (the Numerator) in the moveable, gives 75. in the fixed; ſo 63. 84. is now changed into a Decimall 75. 100. the ſame in value with 63. 84. and ſo of any other Fraction that is not decimall.

This for Lineary Proportion.

Of the Golden Rule, or Rule of Proportion, in reſpect of Lines and Quantities in plaine Figures.

Pro. 1. IF the demand be of the quantity, *As if the Diamiter of a Circle be 7. and the Area* 38. and 5. 10. *what is the Area of another Circle whoſe Diameter is* 18. *Foot.*

Conſtructio. Bring the line knowne to the other line, that is 7. to 18. ſo right againſt 38. and 5. 10. in the moveable is 99. in the fixed, which looked out in the moveable, right againſt it in the fixed is 254. and 5. 10. the Area of that Circle.

In like manner conſider of Squares, Triangles, and other plaine Figures.

Pro. 2. *If a peece of Land of* 20. *Pole ſquare be worth* 30. li. *what is a peece of Land of the ſame goodneſſe worth, which is* 35. *Pole ſquare every way.*

Conſtructio. Bring 20 to 35. ſo right againſt 30. in the moveable you have 52. and 5. 10. in the fixed; and right againſt this 52. and 5. 10. in the moveable you have 91. and 8. 10. in the fixed, the worth of that land.

Pro. 3. *If a peece of ground of* 50. *paces ſquare is ſufficient to lodge an Army of* 1600 *men, how many men ſhall there be lodged in a peece of ground which is* 40. *paces ſquare*

Conſtructio. Bring 50. to 40. ſo right againſt 1600. in the moveable is 1280. in the fixed, which in the moveable is 1024 ye anſwere.

Pro. 4. *Our Engliſh land meaſure is* 16. *foot and a halfe to the Pole, the Iriſh Pole hath* 21. *foot, how many Engliſh Acres doth* 30. *Iriſh Acres make.*

Conſtructio. Bring 16. and 5. 10. to 21. then right againſt 30. in the moveable is 38. and 2. 10. in the fixed, and right againſt this 38. and 2. 10. in the moveable is 48. and 6. 10. in the fixed, and ſo many Engliſh Acres is contained in 30. Iriſh Acres, &c.

☞ Our uſuall meaſures in England to the Pole are 16. foot and a halfe 18. or 20. foot, the proportion of their ſquares are 68. 81. 100. I have ſet their meaſures to thoſe numbers in the Grammelogia.

Now if the quantity be given and his meaſure, and the quantity be required according to another meaſure, you may have it with greater expedition: for bring the meaſure whoſe quantity is required to the other meaſure, ſo againſt the quantity knowne in the moueable, you have the quantity required in the fixed.

Of

Of the Golden Rule, or Rule of Proportion in reſpect of Lines, and the quantity of Solids.

Pro.1. SO if in ſome ſtately ſtructure the Columes were to bee ſupported with Cubes of Silver, or other rich Materiall, differing in their quantity, an eſtimate of their charge might be quickly had; *As admit the ſide of the leaſt Cube were 4. Inches, and could not be made under* 12. li. *what might a Cube of the ſame mettall be worth that is but one inch more in the ſide,* viz. 5. *inches.*

Conſtructio. Bring 4. to 5. ſo right againſt 12. in the moveable, is 15. in the fixed, and right againſt this 15. in the moveable is 18. and 75. 100. in the fixed, and right againſt this 18. and 75. 100. in the moveable is 23. li. and 4. 10. in the fixed, and ſo much will the ſecond Cube coſt: *this might bee applied to the weight, worth, or quantitie of other Solids.*

Pro.2. *A Peece of* 5. *Inches boare or Diameter, requires for her charge* 16. *pound of Powder, what quantity of Powder will ſerve another Peece of* 4. *Inches in the boare.*

Conſtructio. Bring 5. to 4. ſo right againſt 16. in the moveable is 12. and 8. 10. in the fixed, and right againſt 12. and 8. 10. in the moveable is 10. and 24. 100. in the fixed; and right againſt this 10. and 24. 100. in the moveable is 8. and 2. 10. in the fixed: the anſwer of Powder according to Cubick proportion, but Canoniers doe ſomewhat qualifie this proprotion.

To finde what Proportion in Quantity there is betweene two or more Solids.

Pro.3. *There are two Bullets, Globes, or Cylenders, the Diameter of the one is* 10. *inches, and the other the Diameter is* 4. *inches, what proportion is there betweene the Solids, or how often doth the greater containe the leſſer.*

Conſtructio. Bring 10. to 4. ſo right againſt 100. in the moveable is 40. in the fixed, againſt this 40. in the moveable is 16. in the fixed; and right againſt this 16. in the moveable, is 6. and 4. 10. in the fixed; ſo the proportion betweene the Solids are as 100. to 6. and 4. 10.

But how often the greater doth containe the leſſer, the Rule enſuing doth teach.

Pro.1.

How to divide one number by another.

Conſtructio. M*Ove the Diviſor to 1. ſo right againſt the Dividend in the moveable, is the quotient in the fixed.*

Declaratio. So if it were demanded, how many daies there is in 216. houres, becauſe a day naturall containes 24. houres, that therefore is the Diviſor. Move then 24. to 1. and right againſt the ſaid 216. in the moveable is 9. in the fixed, and ſo many daies is 216. houres.

☞ Here note that in all *Diviſions*, by how many figures or places the Dividend exceeds the Diviſor, ſo many places or figures ſhall the *Quotient* have. But if the figures of the Diviſor may be taken from as many of the firſt figures or places towards the left hand of the *Dividend*, then the *Quotient* ſhall have one place more.

Example 2. *So if it were further required, how many daies there were in 360. houres, or any other number*: the Inſtrument not moved from his firſt ſetting, they are all given at one inſtant: for right againſt the number in the moveable, is the anſwer in the fixed, ſo right againſt 360. in the moveable is 15. in the fixed, and ſo many daies are there in 360. houres.

This note ſerves onely to know the number of Figures or places in the Quotient, by which the denomination of the firſt figure of the Quotient may be had.

Example 3. *So if it were demanded how many yeares there is in 14600. daies, there being 365. daies in the yeare*: this therefore is the Diviſor. Bring then 365. to 1. ſo right againſt 14600. in the moveable is 4. in the fixed, but by the former note ☞ it muſt be 40. and ſo many yeares is there in 14600. daies, the Inſtrument not moved, right againſt any number of daies, as 5000. 10000. 20000. &c. in the moveable, is the yeares in the fixed. With the ſame expedition and facility may you divide by fractionall numbers.

Further uſes upon Diviſion.

IN a yeare are 52. weekes or 365. daies. If J would know the weekly expences of any yearely ſumme of money. *Example 4.*

Bring 52. to 1. then right againſt any ſumme of money in the moveable, you have the weekly expences in the fixed: *Conſtructio.*

But if you move 365. to 1. then right againſt any ſumme of money in the moveable, you have the daily expences in the fixed.

So if the expences yearely were 1000. li. or the charge of a certaine Company of Souldiers: right againſt it according to the note ☞ of Diviſion is 2. li. 7. 10. the daily charge: the Inſtrument not removed, you may ſee at one inſtant the daily charge of 20000. li. a yeare, 50000. li. or 100000. li. a yeare: for right againſt the charge or expence in the moveable, is the anſwer in the fixed. *Declaratio.*

More uſes upon Diviſion.

It is ſaid that Land is bought after the rate of 14. yeares purchaſe: if 14. be therefore brought to 1. right againſt any ſumme of mony in the moveable, you have the Annuall Rent in the fixed anſwerable to that money. And thus you have lying before you a whole Circularity of Numbers, by which at one inſtant, doe but ſpeake the ſumme of money, right againſt it is his Rent. *Example 5.*

But if the Rent were given and the Purchaſe required, it is the inverſe of this, and is proper to Multiplication, and the Rule followeth in the next page.

Other uſes upon Diviſion to finde the Scale to divide the Meridian line in a Sea Chart, according to any bredth, & to a Latitude aſſigned.

Let the bredth of the Chart extend from the Latitude of 30. unto 40. the degrees of the Equator anſwerable to the difference of thoſe Latitudes, according to M. *Wrights* projection, are 12. & 24. 100. Bring this 12. & 24. 100. to 1. ſo right againſt the bredth of the Card in the moveable, you have the Inches, or parts of Inches in the fixed to make your ſcale by to divide the Meridionall line. *Example 6.*

So if the bredth of the Card were 33. Inches, right againſt it in the fixed is 2. Inches, 7. 10. the largeneſſe of a degree of the Equator: if the bredth were 24. & 5. 10. right againſt it is 2. Inches: if 20. & 8. 10. then the bredth of a degree is 1. & 7. 10. if 14. & 7. 10. then 1. & 2. 10. if 8. & 5. 10. then 7. 10. &c. *Declaratio.*

To multiply one Number by another, or to finde the Product of two Numbers.

Conſtructio. MOve 1. to the multiplier, then right againſt the Multicand in the moveable Circle, you have the Product in in the fixed Circle.

☞ Here note that the Product of any *Multiplication*, is ever as many figures or places, as there are places or figures contained in the *Multiplicand* and *Multiplier*, if the two firſt Figures towards the left hand being multiplied together have excreſcence (that is, if the Product exceed 9) otherwiſe the Product ſhall bee one figure or place leſſe than there are figures or places contained both in the *Multiplicand* and *Multiplier*.

Declaratio. *So if 38. be multiplied by 2. the Product will be but two places:* But if the ſaid 38. be multiplied by 5 the Product will be three places, for that 3. by 2. multiplied doth not creſcere, but the ſaid 3. by 5. doth beare excreſcence, *viz.* more than 9.

This Note is only to give domination to the firſt figure of the Product towards the left hand, for if the Product have two figures, then the firſt figure of that Product towards the left hand is ten or tens; if the Product have three figures, then the firſt figure of the Product towards the left hand is hundreds, &c.

Example 2. To *Multiply* 18. by 5. Bring 1. to 5. then right againſt 18. in the moveable is 9. in the fixed, which by the former note ☞ of obſervation is 90. which is the Product of 18. by 5.

But if 35. were to bee multiplied by 4. move 1. to 4. ſo right againſt 35. in the moved is 140. by the laſt note ☞.

Example 3. *To multiply Fractionall*, as 40. and 5. 10. by 7. and 3. 10. Bring 1. to 7. and 3. 10. ſo right againſt 40. and 5. 10. in the moveable is 295. and 6. 10. in the fixed; the Product required.

So to *multiply* 8. 10. by 5. 10 Bring 1. to 5. 10. ſo right againſt 8. 10. in the moveable is 4. 10. in the fixed.

Vſes

Vſes upon Multiplication.

Example 3.

12. *Monetht make a yeare, bring* 1. *unto it, ſo right againſt any monethly expences in the moveable you have the yearely expences in the fixed, according to the note* ☞ : So if the monethly expences were 75. li. right againſt it in the fixed is 9. which by the former note ☞ makes 900. if 150. li. for a moneth, right againſt it in the fixed is 1800. li. the yearely charges or expences.

Other uſes upon Multiplication.

Example 4.

60. *Minutes make an houre*, bring 1. to 60. ſo right againſt any number of houres in the moveable is the minutes of thoſe houres in the fixed.

Further upon Multiplication.

Example 5.

Admit lands be ſold at 14. *yeares Purchaſe*, bring 1. to 14. ſo againſt any Rent in the moveable you may at one inſtant ſee the purchaſe thereof in the fixed, having regard to the former note ☞.

How to ſquare a Number.

Example 6.

To ſquare 18. bring 1. to 13. ſo right againſt 18. in the moveable is 324. in the fixed, the ſquare of the ſaid 18. In like manner may you ſquare whole numbers and fractions, as to ſquare 13. and 5.10. *facit* 182. and 25.100.

How to Cube a Number.

Example 7.

As to Cube 6. and 2.10. bring 1. to 6. and 2.10. ſo right againſt 6. and 2.10. in the moveable is 38. and 4.10. in the fixed, and right againſt 38. and 4.10. in the moveable is 228.$\frac{3}{10}$ in the fixed, the Cube of 6. and 2.10.

Againe to Cube 6. bring 1. to 6. for right againſt 6. in the moveable is 36. in the fixed; and right againſt this 36. in the moveable is 216. in the fixed, the Cube of 6. &c.

To finde Numbers in continuall proportion unto any two Numbers aſſigned.

Conſtructio. BRing the firſt number to the ſecond, then right againſt the ſecond upon the moveable, is the third number in the fixed, and againſt this third number in the moveable, is the fourth number in the fixed, &c.

Declaratio. So if the numbers to be continued in proportion be 2. to 4. move 2. to 4. ſo right againſt 4. in the moveable is 8. in the fixed, and 8. in the moveable gives 16. in the fixed, and thoſe numbers, 2.4.8.16 &c. are ſaid to be in continuall Proportion.

Example 2. Againe, if I would continue a Proportion, as 2. to 3. move 2. to 3. then 3. in the moveable ſhall point out 4. & 5. 10. in the fixed, and 4. & 5. 10. in the moveable ſhall give 6 & 7. 10. i in the fixed, and ſo on (if need were) to finde others: and thoſe numbers are ſaid to bee in continuall proportion one unto another.

☞ The increaſe or intereſt of *Money* from this ground is eaſily found, ſeeing the increaſe of the *Money* muſt bee in continuall Proportion to the Principall, as 100. li. is to his Intereſt.

Example 3. As if the Proportion were to be continued to 40. li. as 100. to 108.

Conſtructio. Move 100. to 108. then againſt 40. in the moveable is 43. li. 2. 10. in the fixed: the firſt yeares Intereſt and its Principall, & againſt this 43. li. 2. 10. in the moveable, is 46. li 8. 10. in the fixed, which is the ſeconds yeares Principall and Intereſt: in like manner may you proceed to other yeares.

☞ *The inſtrument being at this ſtay*, the eye may denote out at one inſtant the Intereſt of any ſumme or Money: for right againſt your number in the moveable, is both Principall and Intereſt in the fixed.

Example 4. As if it were 27. li. 14. s. (that is, 27. li. 7. 10.) right againſt it is 30. li. *ferè*, and ſo much doth 27. li. 14. s. come to at the yeares end, and ſo all other ſummes of money doe offer themſelves at one inſtant to the eye in their reſolutions.

Pro.1.

To finde a meane proportion, or many betweene any two Numbers given.

MArk what number of equal parts in the *fixed* is againſt each of the given numbers,(which equall parts repreſent the *Logarythmes* of theſe *numbers*,if the *Logarythmall Index* be put unto them,which is a unity leſſe then the places of *any given number*) and adde theſe *Logarythmes*,or equall parts together, then take the halfe of that ſumme, which ſought out in the former *Circle* of equall parts, right againſt it in the *Circle of numbers* is the meane proportionall required, or the halfe difference of theſe two *Logarythmall numbers*,or equall parts being added to the leſſer *Logarythme* will give the ſame,or ſub.&c.

But if many meane proportionalls be required divide the differentiall *Logarythme* of the two numbers, or number of equall parts,by a unity more then the number of *meane proportionalls*,which quotient being by ſucceſſion added to the *Logarythme* or equal parts belonging to the leſſer number,doth ſhew the ſeverall *meane proportionalls* required. So if betweene the *Cubicke numbers* 27. and 64. two *meane proportionalls* were required,the third part of the difference of equall parts betweene theſe numbers is 125.which being added unto 431. the equal parts againſt 27. makes 556. againſt which in the Circle of numbers is 36. the firſt *meane proportionall* unto which 556. againe adde ſucceſſively the ſaid 125.which makes 681. againſt theſe equall parts in the *Circle of numbers* is 48.the other *meane proportionall.*

According to the ſame manner betweene 243.and 1024.foure *meane proportionalls* might be found,to wit,324.432.576.and 768.Or proportions may be found to a tearme aſſigned, betweene two numbers, either by augmentation from a greater,or diminution from a leſſer.

Of the Extracting of ſquare, and Cubicke Roots,and others.

THe conſtruction of this depends upon the latter,becauſe the *ſquare Roote* of any number,is nothing but a *meane proportion* betweene a *unity* and the given *number*,the *Cubicke Roote* is the firſt of two *meane proportionalls*,betweene the *unity* and the *Cube* propoſed. the *Biquadrat Roote*, is the firſt of three *meane proportionalls* betweene the *unity* and the *given number*,*&c.* But becauſe the former direction ſpecified in finding of *meane proportions* ,adheres unto the way and nature of *Logarythmes*, it being more facil by them,then ſo to apply it Inſtrumentally, therefore we will ſomewhat compendiate that labour by the Inſtrument alone,and avoyd the ſearch of the *Logarythmes of numbers*, and their partitions,and as an eaſe for Radicall extractions.

To

To finde a meane proportionall with more facility then is formerly delivered

Conſtructio. Marke what number of equall parts in the *Circle of equall* parts E, in the fixed is againſt the leſſer of the two given *numbers* in the *Circle of numbers* in the fixed.

then bring the *leſſer number* in the *moveable* to theſe parts in the *Circle of equall parts* noted with *Q* betweene	*Q A*	if theſe two numbers have	like places or exceede one another by even places.	ſo the like number of equall parts in the fixed in the *Circle Q* which is againſt the greater *number* in the *Circlc of equal* parts E, being ſought out betweene *Q A*, in the *fixed* ſhall right againſt it point out the *meane proportionoll* in the *mooveable.*
	A Q		exceede one another by odde places.	

But here note that 10. in this *Rule* muſt be accounted to have but one place, 100. to have but two places, 1000. three places, &c.

For the extraction of ſquare and Cubicke Roots more compendiouſly, thats done by an inſpection of the eye onely. as is ſpecified in the aforeſaid *Epiſtle to the Reader*, at the laſt clanſe of the uſe of the *Instrument*, without *motion* : but hereafter more in that nature. And by the way, note that in the *extraction of ſquare Rootes*, the *Roote* doth containe in places alwayes the juſt halfe of the places of the *number given* if it hath even places, but if it have *odde places*, then the *Roote* hath as many places as the greater halfe comes to.

Now as every two places in *ſquare numbers*, affords one place for its *Roote* : ſo *Cubicke numbers*, affords for every third place, or ternarie one for its *Roote* : but if the number have any places above, the *ternarie* or *ternaries* of places, then the *Roote* ſhall be one place more then the *number of ternaries.*

☞ Note further, that in ſeeking of *meane proportionalls* it may bee doubtfull what *denominations* to give unto it when it is found on the *Inſtrument*, which may bediſcovered in this manner; finde the places that the two extreame numbers given wonld make if they were multiplyed together, which the Rule in *Multiplication*, Pag. 14. will ſhew you; then having the number of places for the *product*, the former *Rule* which doth allude to the places for the *ſquare Roote*, will tell you what denomination to give the *meane proportion* ſought for.

To finde a meane proportion betweene two numbers. Pro. 1.

NOte if the two Numbers have like places, or exceed one another by two places, move the numbers to and fro, untill 1 in the fixed be equally diſtant betweene them, which the diviſions in the pricked Circle *A B* will helpe you; ſo right againſt 1. in the fixed, is the mean proportiō in the moveable.

2 *If the two numbers* exceed one another by one, or three places, move the numbers to and fro, untill 1. in the fixed bee equall diſtance betweene them; ſo right againſt *B* in the moveable is the meane Proportion.

Some uſes upon meane Proportionals.

To find how much is taken in the 100. li. in Loane of mony. Pro. 1.
If 40. li. *be lent for two yeares, and at the end thereof were received* 48. li. and 4. 10. *what was taken in the* 100. *Declaratio.*

Finde a meane proportion betweene 40. and 48. 4. 10. which will be 44 according to the laſt rule; ſo right againſt 48. 4. 10. in the moveable, is 110. in the fixed, which is the Principall and its Intereſt; ſo ten pound is taken *per centum*.

Pro. 2. *In warlike diſcipline, the weakeſt place oppoſed to danger, is ſupplied with ſtrongeſt force.* *Pro. 2.*

Now there are two companies allotted for two ſeverall ſervices, the one containing 500. Souldiers, the other 320. Souldiers, there is a third place, neither ſo ſtrong as the latter, nor ſo weake as the former, therefore a meane number of Souldiers is thought convenient for the defence thereof: what number ſhall it be?

Finde a meane proportion betweene 500. and 320. *facit* 400. and this is a meane proportionall number betweene 320. and 500. and the number of men required.

Pro. 3. *To finde the Scale that protracted a Plot or Building by.* Pro. 3.

Let the Rectangle A C be 8. *Acres, and let the Scale be ſought for by which it was protracted or plotted:* *Declaratio.* *Conſtructio.* With any Scale meaſure the ſide *A B*. admit of 10. parts in an inch, and ſuppoſe it make 33. & 33. 100. parts, and *A D*. 26. & 66. 100. parts, according to which the *Area* of the Rectangle now is 5. *Acres* and 56. 100. parts; finde a meane proportion between this and the former 8. Acres, which is 6. & 67. 100. and this ſtands againſt 1. in the fixed, which repreſents 10. his ſcale, but 8. in the moveable gives 12. in the fixed, and ſuch were the parts in an Inch of the ſcale ſought for.

How

Pro. 1.

How to extract the Square Root by the Grammelogia.

Conſtructio. Let 1. in the fixed ſtand toward you, and ſeeke that number to be extracted in the moveable, if it have 1. 3. 7. or 9. places, &c. bring the number towards the left ſide of 1. in the fixed: but if the number have 2.4.6. or 8. places, &c. bring it twards the right ſide of the fixed 1. and move your number to and fro, untill 1. in the moveable bee as farre diſtant from 1. in the fixed, as your given number is from 1. in the fixed: (the equall parts in the Circle *AB* will helpe you in this) ſo the number in the moveable right againſt the fixed 1. is the Root ſought for.

Here note that 1. or 2. figures hath but one figure for his Root, 3. or 4. figures hath 2. figures or places for its Root, 5. or 6. figures hath 3. figures for its Root, &c.

How to extract the Cubicke Root.

Vpon the moveable there are thoſe letters *A.B.C.* the diſtance betweene *A. B.* is divided into 10. equall parts, and each part ſubdivided: the diſtance betweene *A.C.B.* is alſo divided into 10. parts, and each part ſubdivided, their uſes may be thus.

Conſtructio. Let 1. in the fixed ſtand alwaies betweene *A* and *B* in the moveable for the *Extraction of Cubicke Roots*, and move the moveable to and fro, untill that the given number and 1. in the fixed be of like number of parts diſtant from *A* in the moveable.

So if the given Number have	1.4.7. or 10.	Places, &c. the Cubicke Root is right againſt	A	In the fixed.
	2.5.8. or 11.		C	
	3.6.9. or 12.		B	

And here note that a number of 1. 2. or 3. places hath but 1. figure for the Root; a Number which hath 4. 5. or 6. places hath but 2. figures or places for its Root; a number which hath 7. 8. or 9. places hath but 3. figures or places for its Root, &c.

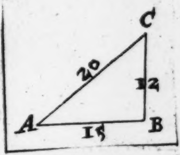
Vſes

Vſes upon the ſquare Root.

Pro. 1. *There are two ſquare formes, the one is 12. every way, and the other 16. every way, if of thoſe two were made one, how many ſhould it be every way in the ſide.* Pro. 1.

Conſtructio. BY the firſt proportion, pag. 16. finde a number in continuall proportion to 16. as 12. to 16. *facit* 21. & 3.10. adde this to 12. *facit* 33. and 3.10. Then by 1. Pro. pag. 17. finde a meane proportion betweene that 33. and 3. 10. and 12. *facit* 20. the ſide of the Square required.

Otherwiſe ſquare [illegible] 12. and 16. according to the eighth example, pag. 15. *facit* 144 and 256. the ſumme of thoſe Squares is 400. and the Root Quadrat of it by Pro. 1. pag. 18. is 20. as before, thoſe extractions ſerve to wonderfull uſes in finding the Diagonals of Rectangles, the Diameters and Axis of Solids, the Area, Difference or Agregate of Figures, as well plaine as ſolid.



Pro. 2. Otherwiſe we might apply the Pro. thus, *A B* is the bredth of a ditch 16. foot, *B C* the heigh of a wall 12. foot, the length of a ſcaling Ladder to reach from *A* to *C*. would bee as before 20.

Pro. 3. *A* and *C* are two Townes, *A* lies Weſt of the Meridian of *C* 16. miles, and *C* lies North of the Parallel of *A* 12. miles, the diſtances of the two Townes would bee as before 20. miles, &c.

Pro. 4. *How to encampe horſe or foot, according to any proportion aſſigned.* Pro. 4.

Declaratio. 240. men or horſe are to be imbatled, that the Flanke to the Front ſhall be in proportion, as 3 to 5. how many ſhall be in the Front, and how many in the Flanke.

Conſtructio. Bring 3. to 5. ſo againſt 24. in the moveable is 400. in the fixed, the ſquare Root of which is the Front *viz.* 20. divide the ſaid 240. by the Front, 20. the Quotient is 12. the Flanke.

In mentall reſervation of a number, to finde that number.

Pro. 5. Let the number be broken into two parts, and to the product of the parts adde the ſquare of the halfe [illegible] difference of the parts, the Root, Quadrate of the Agragate is halfe the number conceived, &c.

Further

Further uſes upon the Grammelogia in the reſolution of Queſtions, touching Intereſt, Purchaſes, valuation of Leaſes, and ſuch like.

☞ NOte that from 1. in the moveable, there is charactered 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. &c. all of equall diſtances, thoſe ſerve for the number of yeares as occaſion requires.

Pro. 1. Pro. 1. *To finde what a ſumme of money comes to, at the end of any number of yeares, accounting 8. li. for 100 per Annum.*

Declaratio. So if 20. li. were forborne 12. yeares, how much doth it come to allowing Intereſt compound at 8. li. for 100. li.

Conſtructio. Bring 1. in the moveable to 20. in the fixed, ſo right againſt 12. yeares in the moveable you have 50. li. 4. 10. in the fixed. And ſo much will 20. li. amount to being forborne 12. yeares.

☞ The Inſtrument not removed, you may at one inſtant ſee the amount of the ſaid 20. li. for any number of yeares or parts of a yeare; for right againſt the time in the moveable, you have the anſwer of the money in the fixed.

Pro. 2. Pro. 2. *To finde what a ſumme of mony which is due any number of yeares to come, is worth in ready mony, allowing 8. li. for 100. li.*

Declaratio. So if the ſaid 20. li. were due 12. yeares hence, what is it worth in Preſent.

Conſtructio. This is only the converſe of the former: bring therefore 12. yeares in the moveable to 20. in the fixed, ſo right againſt 1. in the moveable is 7. li. 94. 100. in the fixed, which is about 7. li. 18. s. 3. d. and ſo much is able to buy the ſaid 20. li. to be received 12. yeares hence.

Pro. 3. Pro. 3. *A yearely Rent of a Leaſe, or a Penſion to be ſold for any number of yeares, to finde the worth thereof in ready money: Or the Rent for any number of yeares being unpaid, to finde what it amounts unto, accounting 8. li. for 100. li. per Annum.*

Declaratio. Let a Leaſe or Penſion of 20. li. *per Annum* be ſold for ready mony, which is in being 12. yeares, how much is it worth?

Conſtructio. Bring 8. to 100. then right againſt 20. li. in the moveable is 250. li. in the fixed; unto this 250. in the fixed bring 12. yeares; ſo right againſt 1. in the moveable is 99. li. 3. 10. in the fixed, which taken out of the ſaid 250. there remaines 150. li. 7. 10. the worth required.

If

If the Rent were behind unpaid 12 *yeares.*

THen bring 1. to the ſaid 250. ſo right againſt 12. yeares in the moveable is 630. li. in the fixed, take the former 250. from this 630. li. it leaves 380. li. and ſo much doth the ſaid Rent of 20. li. *per Annum* amount to forborne 12. yeares at 8. li. for 100. li. *per Annum.*

Pro. 4. *A ſumme of money borrowed, and a Leaſe ingaged for that money, to finde how long the Leaſe ought to be kept.*

***Pro.* 4.**

Declaratio. Let 300. li. be borrowed upon a Leaſe in being 20. yeares, of 50. li. a yeare, how long ſhall the Rent be received, that neither be damaged one by the other, accounting 8. li. for 100. li. *per Annum.*

Conſtructio. Bring 8. to 100. ſo right againſt 50. in the moveable is 625. in the fixed: from this 265. li. ſubtract the mony borrowed, *viz* 300. li. it leaves 325. li. then bring 1. to this 325. in the fixed; ſo right againſt the ſame 625. in the fixed, is 8. yeares 5 10. in the moveable, and ſo long time ſhall the Lender of the Money enjoy the Borrowers Leaſe, after 8. li. for 100. li. *per Annum.* This may be inverted, knowing the Summe and time to finde the Rent.

Pro. 5. *A Leaſe to beginne for yeares to come, and then to continue for any number of yeares, to finde the worth thereof in preſent, accounting Intereſt Compound at* 8. li. *for* 100. li. *per Annum.*

***Pro.* 5.**

Declaratio. Let a Leaſe of 40. li. *per Annum* beginne 7. yeares hence, and then to continue 10. yeares after; if it were to bee ſold, what is it worth in ready money?

Conſtructio. By the third *Pro.* finde the worth thereof in the preſent for the 10. yeares, *facit*, 268. li. 4. 10. then by the ſecond *Pro.* finde what that 268. li. 4. 10. is worth in preſent if it were to be received 7. yeares hence, *facit*, 156. li. 6 10. and ſo much is the ſaid Leaſe of 40. li. *per Annum* worth, which is to beginne 7. yeares hence, and then to continue unto 10. yeares.

Thus I might have gone further in thoſe matters, but I intended not to be large in this Tract, onely ſhewing what weighty, and difficult matters in this kinde by the *Grammelogia*, or *Mathematicall Ring*, may bee eaſily and ſpeedily reſolved.

Concluſio.

Concluſion.

IF there be compoſed three *Circles* of equal thickneſſe, *A. B. C.* ſo that the inner edge of *B* and the outward edge of *A* be anſwerably graduated with *Logarithmall ſignes*, and the outward edge of *B* and the inner edge of *A* with *Logarithmes*; and then on the backſide be graduated the *Logarithmall Tangents*, and againe the *Logarithmall ſignes* oppoſitly to the former graduations, it ſhall be fitted for the reſolution of *Plaine* and *Sphericall Triangles*.

Example. So if you move the *Signe* of 90. Degrees vnto the *Tropicall point* in the fixed, you have the *Declination* of any Degree of the *Eclipticke* onely by an *ocular inſpection*, for right againſt the *Sunnes longitude* in the moveable amongſt the *Signes*, is the *Sunnes declination* in the fixed.

Againe, in the Circle of *Tangents*, if you bring the *complement* of any *Latitude* in the moveable to 45. in the fixed, you may at one inſtant have the time of *Sun riſing* or *Sun ſetting* for any *Declination* required in that *Latitude*; for right againſt the *Tangent* of the *Suns Declination*, you have the ſine of the *Suns aſcentionall difference*: and in plaine *Triangles* the operations are performed with like facility.

Hence from the forme, I have called it a *Ring*, and *Grammelogia* by annoligie of a *Lineary ſpeech*; which *Ring*, if it were projected in the *Convex* unto two yards *Diameter*, or there abouts, and the line *Decupled*, it would worke *Trigonometrie* unto ſeconds, and give *proportionall numbers* unto ſix places only by an *ocular inſpection*, which would compendiate *Aſtronomicall calculations*, and be ſufficient for the *Proſthaphæreſis* of the Motions: But of this as God ſhall give life and ability ſo health and time.

FINIS.

This *Inſtrument* is made in Silver, or Braſſe for the Pocket, or at any other bigneſſe, over againſt Saint *Clements Church* without *Temple Barre*, by *Elias Allen*.

CHARLES *by the grace of God*, King *of* Great Britaine, France, *and* Ireland, *Defender of the Faith, &c. To all our loving Subjects whom it may concerne greeting: Whereas* Richard Delamain, *Teacher of the* Mathematicks, *hath preſented vnto Vs an* Inſtrument *called* Grammelogia, *or* The Mathematicall Ring, *together with a Booke ſo intituled, expreſſing the uſe thereof, being his owne* Invention; *we of our Gracious and Princely favour have granted unto the ſaid* Richard Delamain *and his* Aſſignes, *Privilege, Licence, and Authority, for the ſole Making, Printing, and Selling of the ſaid* Inſtrument *and* Booke: *ſtraightly forbidding any other to Make, Imprint, or Sell, or cauſe to be Made, or Imprinted, or Sold, the ſaid* Inſtrument *or* Booke *within any our* Dominions, *during the ſpace of* ten yeares *next enſuing the date hereof, upon paine of Our high diſpleaſure. Given under our hand and Signet at our Palace of Weſtminſter, the fourth day of* Ianuary, *in the ſixth yeare of our Raigne.*

Vpon his Ring.

AS in a ſecret *Circle* wrapt lies natures *myſteries,*
Which time brings forth, & induſtry makes plaine to all mens eyes,
So that what erſt was hard to finde, at length is wrought with eaſe,
Rules of *Proportion*, the *Roots Extraction*, and theſe
With ocular inſpection now: Alſo *Triangles* Plaine
And Sphæricall; for *Queſtions* ſoone an *Anſwer* to obtaine;
That it makes *Arts* laugh his quickneſſe to ſee, then uſe this *Ring*,
The *Circle* where, hid *Arts* lie now themſelves diſcovering.
If after times ſhall ſeeke more eaſe than in this eaſineſſe
By *Inſtrument*, he makes *Arts* lame, with eaſes great exceſſe.

By a Friend.

THe *Ægyptian Sages*, who were wont to ſing
In the *Hiroglyphicks*, their Philoſophie;
Portrai'd the yeare in ſemblance of a *Ring*,
Cauſe ſo the yeare round in it ſelfe doth lie.
Thy *Mathematicke Ring* is more profound,
A world of Art lies in that little Round.

FINIS.

To the Reader.

NOw by way of advertiſment to the *Reader*, in this *Circular* projection of *Logarithmes*, you may make uſe of the Projection of the *Circles* of the *Ring* upon a *Plaine*, having the feet of a paire of *Compaſſes* (but ſo that they be flat) to move on the *Center* of that *Plaine*, and thoſe feet to open and ſhut as a paire of *Compaſſes* (which ſome call a *Sector* abuſively) now if the feet bee opened to any two termes or numbers in that *Projection*, then may you move the firſt foot to the third number, and the other foot ſhall give the *Anſwer*; and ſo moving thoſe feet along *Circularly*, as one foot paſſeth by any number in the *Projection*, the other foot ſhall ſhew his proportionall number in that *Projection*; it hath pleaſed ſome to make uſe of this way. But in this there is a double labour in reſpect of that of the *Ring*, the one in fitting thoſe feet unto the numbers aſſigned, and the other by moving them about, in which a man can hardly accomdate the *Inſtrument* with one hand, and expreſſe the *Proportionals* in writing with the other. By the *Ring* you need not but bring one number to another, and right againſt any other number is his *Anſwer* without any ſuch motion. But this or the former I leave to ſuch as ſhall beſt affect them, only the latter for *Conſtruction* I account moſt *facile*, and for *expedition* moſt *excellent*, and upon that I write, ſhewing ſome uſes of thoſe *Circles* amongſt themſelves, and conjoyned with others, in the reſolution of ſuch *Queſtions* which are ordinarily practiſed in *Aſtronomy*, *Horolographie*, in plaine *Triangles* applyed to *Dimenſions*, *Navigation*, *Fortification*, &c. as a preparative ground for a more ample worke, and as a declaration of the *admirable*, and *excellent* uſe of this *Ring* in expedition, and facility. But before I come to *Conſtruction*, I have thought it convenient by way of introduction, to examine the truth of the graduation of thoſe *Circles* which may be from the enſuing *Tables* and directions.

Of the Examination of the Graduation of the Circles of the Ring, which may ſerve as an inducement and furtherance to the Learner, to fit and acquaint him how with promptneſſe to conceive of oppoſite numbers in the anſwering of Queſtions following.

FIrſt, to examine the Circle of *Numbers*, bring any number in the moveable to halfe of that number in the fixed: ſo any number or part in the fixed ſhall give his double in the moveable, and ſo may you trie of the thirds, fourths, &c. of numbers, *vel contra.*

2. Bring 2. in the moveable unto 3. in the fixed, ſo againſt 3. in the moveable is 4. and 5. tenths in the fixed, againſt 4. and 5. tenths in the moveable is 6. and 75.100. in the fixed, and ſo may you goe on in trying the diviſions of the Circle of Numbers in continuall proportion to other numbers, according to the *Table A.*

3. The *Inſtrument* not removed from the rectification of 2. unto 3. right againſt 3. in the moveable is 4. and 5. tenths in the fixed, and againſt 4. in the moveable is 6. in the fixed, but againſt 4. in the fixed is 2. and 66. 100ths in the moveable; againſt 5. in the moveable is 7. & 5. tenths in the fixed, but againſt 5. in the fixed is 3. and 33. 100ths in the moveable, and ſo may you proceede in examining farther, according to the *Table B.* in which *M.* at that head of the Table ſignifieth moveable, and *F.* at the head of the Table ſignifieth fixed, and ſo againſt the numbers under *M.* or *F.* is one anothers anſwer.

4. Bring 3. in the moveable unto 2. in the fixed, ſo right againſt the *ſine* of 90. in the moveable is 41. gr. 44. m. in the fixed; againſt 60. gr. is 41. gr. 02. m. againſt 75. gr. in the moveable is 40. gr. 05. m. in the fixed, and ſo you may examine further, as in the *Table C.*

5. To examine the *ſines* amongſt them ſelves in *continuall proportion*, as 6. gr. to 7. gr. bring 6. gr. in the moveable to 7. gr. in the fixed, ſo right againſt 7. gr. in the moveable is 8. gr. 10. m. in the fixed, and right againſt this 8. gr. 10. m. in the moveable is 9. gr. 32. m. in the fixed, and ſo may you goe on in examining other *ſines* on the *Inſtrument* in *continuall proportion*, according to the *Table D.*

6. The *Inſtrument* being at this ſtay againſt 10 gr. in the moveable is 11. gr. 41. in the fixed, but againſt 10. gr. in the fixed is 8. gr. 34. m. in the moveable; againſt 15. gr. in the moveable is 17. gr. 34. m. in the fixed, but againſt 15. gr. in the fixed is 12. gr. 50. m. in the moveable, and ſo may you examine other *ſines*, according to the *Table E.*

7. In the examination of the graduation of the *Tangents*: the *Inſtrument* not removed right againſt the *Tangent* of 6. gr. in the moveable is the *Tangent* of 7. gr. & the *ſine* of 7. gr. 3. m. in the fixed; againſt the *Tangent* of 7. gr. in the moveable is the *Tangent* of 8. gr. 9 m. & the *ſine* of 8. gr. 14. m. in the fixed, againſt the *Tangent* of 8. gr. in the moveable is the *Tangent* of 9. gr. 18. m. & the *ſine* of 9. gr. 26. m. in the fixed, & ſo may you examine further according to the *Table G.*

A	
M	F.
2	3
3	4. 5
4. 5	6. 75
6. 75	10.10
10. 10	15.2
15.2	22. 8
22.8	34. 2
34.2	51. 2
51.2	76. 9
76.9	115.4

B			
M		F	
2	F	3	M
3	4. 5	3	2.0
4	6. 0	4	2.66
5	7. 5	5	3.33
6	9. 0	6	4.00
7	10.5	7	4. 66
8	12.0	8	5. 33
9	13.5	9	6. 00
10	15.0	10	6. 66
15	22. 5	15	10.00
20	30. 0	20	13.33
25	37. 5	25	16.66
35	52. 5	35	23.33
45	67. 5	45	30.00
55	82. 5	55	36.66
65	97. 5	65	43.33
75	102.5	75	50.00
85	127.5	85	56.66
95	142.5	95	63.33
100	150.0	10	66.66

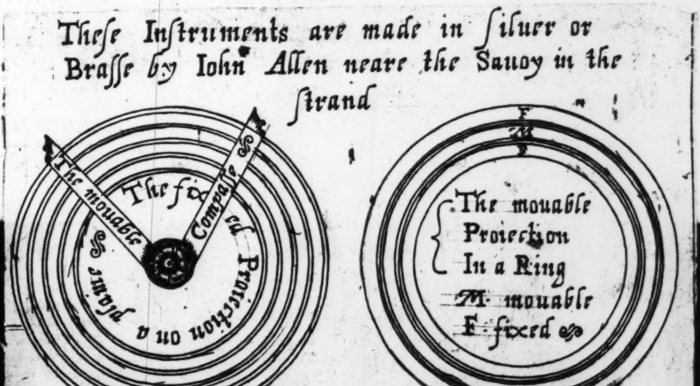
D	
M	F
6. 0	7. 0
7. 0	8. 10
8. 10	9. 32
9. 32	11.08
11.08	13.00
13.01	15.13
15.13	17.50
17.50	20.55
20.55	24.35
24.35	29.20
29.01	34.27
34.27	41.15
41.15	50.15
50.15	63.41

E			
M		F	
6	F	7	M
10	11.41	10	8. 34
15	17.34	15	12.50
20	23.03	20	17.04
25	29.31	25	21.15
30	35.39	30	25.24
35	41.58	35	29.28
40	48.33	40	33.27
45	55.32	45	37.20
50	63.16	50	41.04
55	72.51	55	44.38
		60	47.58
		65	51.00
		70	53.42
		75	55.56
		80	57.38
		85	58.42
		90	59.04

C	
90	41.49
80	41.02
75	40.05
70	38.47
65	37.10
60	35.16
55	33.06
50	30.42
45	28.07
40	25.22
35	22 29
30	19.28
25	16.22
20	13.10
15	9. 56
10	6. 39

G											
M	F	F	M	F	F	M	F	F	M	F	F
	T	S		T	S		T	S		T	S
6	7. 0	7. 3	16	18.29	19.32	26	29.38	34.39	36	40.16	57.54
7	8. 9	8. 14	17	19.37	20.52	27	30.43	36. 27	37	41.18	61.28
8	9. 18	9. 26	18	20.45	22.16	28	31. 48	38.19	38	42.20	65.23
9	10.28	10.38	19	21.52	23.40	29	32. 52	40.15	39	43.22	70.46
10	11. 37	11.51	20	23.00	25.06	30	33.57	42.18	40	44.22	78.03
11	12.46	13.06	21	24.07	26.35	31	35.00	44.28			
12	13.55	14.21	22	25.14	28.06	32	36.04	46.46			
13	15.04	15.37	23	26.20	29.40	33	37.09	49.15			
14	16.12	16.54	24	27.26	31.16	34	38.11	51.51			
15	17.21	18.12	25	28.52	32.56	35	39.14	54.33			

A Type of the Ringe and Scheme of this Logarithmall projection, the uſe followeth.


Theſe Inſtruments are made in ſiluer or Braſſe by Iohn Allen neare the Sauoy in the ſtrand
The mouable
The fixed
Compaſſe
Proiection on a plaine
F
M
The mouable Proiection In a Ring
M mouable
F fixed

In Aſtronomie.

Pro. 1. *The ſunnes place or diſtance from the Æquinoctiall points knowne, to find his Declination.*

Conſtructio. BRing the *ſine* of 90. in the moveable unto the *ſine* of the Tropicall point, viz. 23. gr. and a halfe in the fixed, ſo right againſt the *ſine* of the degree of the *Suns* neereſt diſtance from ♈ or ♎ in the moveable is the *ſine* of the *Suns* declination of that degree in the fixed.

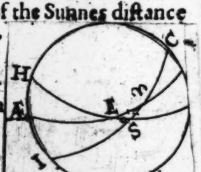
Declaratio. So if the *Suns* place where in the beginning of ♊. ♌. ♐. or ♒. which is 60. gr. of diſtance from the *Æquinoctiall* points; right againſt this 60. gr. in the moveable, is the *Declination* in the fixed, viz 20. gr. 12. m. if the diſtance were 15 gr. 12. m. the *Declination* would be 6. gr. if 10. gr. of diſtance this in the moveable gives 3. gr. 58. m. in the fixed, if the Sunne have 3. gr. of diſtance this in the moveable gives 1. gr. 12. m. in the fixed.

Otherwiſe you may turne the 3. gr. or ſuch which are leſſe) into minutes by allowing 60. minuts to a degree which 3. gr. makes 180 m. minuts, this ſought out in the moveable amongſt the *Numbers* gives 72. minuts in the fixed, which is 1. gr. 12. m. of *Declination* as before: But if you make a degree to containe 100. minuts or parts, then the 3. gr. will be 300. minutes or parts, ſo right againſt this in the moveable amongſt the *Numbers* is 120. in the fixed, which is 1. gr. & 20. hunderth of a gr. of *Declination*. The *Inſtrument* being not removed, you may have the *Declination* for any other parte of the *Eeclipticke*, as for 1. minut for right againſt 60. *ſeconds* in the moveable (which is anſwerable to 1. minut) is 24 *ſeconds* in the fixed, the declination belonging to 1. minute, &c.

Pro. 2. *To finde the Sunnes amplitude, or diſtance of riſing or ſetting from the Eaſt or Weſt knowing the Sunnes place and Latitude.*

Conſtructio. Bring the *ſine* of the Complement of the *Latitude* in the moveable unto the *ſine* of 23. gr. 30 m. in the fixed, ſo againſt the *ſine* of the Sunnes diſtance from ♈ or ♎ in the moveable is the *ſine* of the *Suns Amplitude* in the fixed.

Declaratio. So the *Latitude* being 51. gr. 30. m. the Complement is 38. gr. 30. m. Bring this to the *ſine* of 23. gr. 30. m. in the fixed: now if the *Sunne* have 90. gr. of *Longitude*: right gainſt this 90. in the moveable is 39 gr. 50. m. in the fixed, the greateſt *Amplitude* of the *Sun* in that *Latitude*.



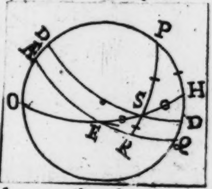
If the *Longitude* were 70. 60. 50. 40. 30. 20. 10. or 5. right againſt any of theſe numbers in the moveable (or any other) is the *Suns Amplitude* in the fixed, viz. againſt the Longitude of ... is

	Amplitude.
70	37. 00
60	33. 42
50	29. 23
40	24. 19
30	18. 38
20	12. 39
10	6. 23
5	3. 12

As for any *Longitude* which is neere the *Equinoctiall* point, the *Amplitude* of it may be had on the Numbers, as in the former Example.

But if the Declination of the Sunne, or a Starre be knowne; the Amplitude may be found thus.

Conſtructio. BRing the *Sine* of the Complement of the *Latitude* in the moveable unto the *ſine* of 90. in the fixed, ſo right againſt the *ſine* of the *Sunne* or *Starres* declination in the moveable, is the *ſine* of the *Sunne* or *Starres Amplitude* in the fixed.



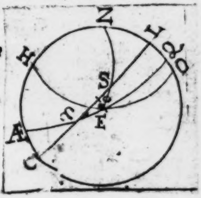
Declaratio. So if the *Latitude* were 51.gr. 30.m. the Complement is 38. gr. 30. m. bring this in the moveable unto the *ſine* of 90. in the fixed, and if the Declination of the *Sunne* or a *Starre* were 20.gr. right againſt this 20. in the moveable is the *Amplitude* in the fixed, viz. 33. gr. 20 .m.

The *Inſtrument* not removed you may for any *Declination* have the *Amplitude* of it: for right againſt the *Declination* in the moveable is the *Amplitude* in the fixed, &c. and there may you ſee what Declination ſuch *Starres* have, which never riſe, or ſet in that *Latitude*.

This *Propoſition* may be inverted and applied to practice in *Navigation* to finde the *Latitude*, by knowing the *Sunnes* place and *Amplitude*, for if you bring the degree of the *Sunnes Amplitude* amongſt the *Sines* in the moveable, unto the degree of the *Sunnes* place in the fixed; right againſt 23.gr.30.m. in the moveable, is the degree of the Complement of the *Latitude* in the fixed.

Pro.3. *In any Latitude to finde what higth the Sunne moſt have to be due Eaſt or Weſt knowing the Sunnes place.*

Conſtructio. Bring the *ſine* of the *Latitude* in the moveable unto the *ſine* of 23.gr. 30.m. in the fixed; ſo right againſt the *ſine* of the *Sunnes* diſtance from ♈ or ♎ in the moveable, is the *Sine* of the *Sunnes* height in the fixed: when he is due *Eaſt* or *Weſt*.



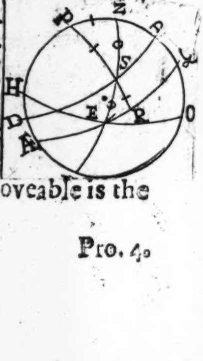
Declaratio. So if the *Latitude* were 51.gr. 30.m. bring the *Sine* of 51. gr. 30. m. in the moveable, unto the *Sine* of 23. gr. 30.m. in the fixed: and if the Sunnes place were from ♈ or ♎ 90. gr. 80. 70.60.50.40.30.20.or 10.gr.

			G.	M.	
Right againſt this	90	In the moveable is	30.	38	in the fixed, the Sunnes height anſwerable to his place.
	80		30.	07	
	70		28.	37	
	60		26.	11	
	50		23.	00	
	40		19.	08	
	30		14.	46	
	20		10.	02	
	10		5.	04	

HEre note that if the *Zenith* be betweene the *Tropickes*, that then the *Sun* ſometimes will not be *Eaſt* or *Weſt*, & what degrees thoſe are you may eaſily try, for any *Latitude*, by moving the moveable ſoftly along, that as the *ſine* of any *Latitude* in the moveable paſſeth by the *ſine* of the *Tropicall* point in the fixed, ſo any degree in the moveable that paſſeth by the *ſine* of 90. in the fixed, doth ſhew that degree to be the greateſt degree of *Longitude* in the *Eclypticke* from ♈ or ♎ that the *Sun* will be due *Eaſt* or *Weſt* in that *Latitude*, and if the *Inſtrument* ſtay at that *Elevation*, any degree of *Altitude* in the fixed doth ſhew his degree of *Longitude* in the moveable, or any degree of *Longitude* in the moveable will ſhew at what *Altitude* the *Sunne* is due *Eaſt* or *Weſt* in the fixed, for the one is oppoſite to the other. *So* if the *Latitude* were 23. gr 30. m. every degree of *Longitude* in the moveable would give the ſame degree of *Altitude* in the fixed to bee due *Eaſt* or *Weſt*; ſo if the *Sunne* be in *Longitude* 20. gr from ♈ or ♎ then the *Sunnes Altitude* would be alſo 20. degrees when it comes due *Eaſt* or *Weſt*: if the *Suns* place be 50. from ♈ or ♎ then the *Altitude* would be 50. to make due *Eaſt*, &c. But if the *Latitude* were leſſe than 23. degrees, 30. m. as admit 15. degrees bring the ſine of this 15. in the moveable unto the ſine of 23. degrees, 30. in the fixed: ſo right againſt 90. degrees in the fixed is 40. degrees, 28. m. in the moveable: ſo when the *Sun* commeth to be in *Longitude*, from ♈ or ♎ above 40 degrees 28. m. that is beyond the 10. degrees, 28. m. of ♉ the *Sun* will not be *Eaſt* or *Weſt* for more than 100. daies, untill hee come to the 59. degree, 32. m. of ♌, and then every day after the *Sunne* will croſſe the *Verticall Circle* of *Eaſt* or *Weſt*, untill the *Sunne* paſſe the other *Equinoctiall* point of ♎.

If the declination of the Sunne or the Starre bee knowne, you may finde the Altitude thereof at the point of Eaſt in any Latitude by this Rule.

Bring the *ſine* of the *Latitude* in the moveable unto the *ſine* of 90. in the fixed: ſo right againſt the *ſine* of any *Declination* in the moveable is the *ſine* of the *Sunnes Altitude* in the fixed.



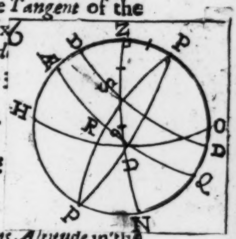
Hence you may conceive, that if the *Zenith* bee betweene the *Tropicks*, then the *Declination* that is equall to the *Latitude*, ſhewes the greateſt *Altitude* to bee *Eaſt*: and any greater *Declination* ſhewes you that the *Sunne* will not be *Eaſt*: but if the *Declination* bee leſſe than the *Latitude*, then right againſt it in the moveable is the *Sunnes Altitude* in the fixed.

Pro. 4.

In Aſtronomie.

Pro. 4. *Knowing the height of the Sunne at the point of Eaſt or Weſt, in any Latitude to finde the houre of the day.*

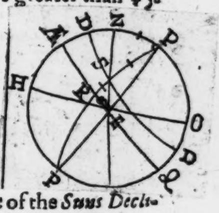
Conſtruct. BRing the *Tangent* of 45. in the moveable unto the *Sine* of the complement of the *Latitude* in the fixed; ſo right againſt the *Tangent* of the *Suns Altitude* in the moveable, is the *Tangent* of the houre from ſix



Declaratio. Let the *Latitude* be 51. gr. 30 m. and the *Suns Altitud*
bring the *Tangent* of 45.gr. in the moveable unto the *Sine* of 38.gr.;
ed, ſo right againſt the *Tangent* of 14 gr. 45.m. in the moveable is 9. gr. 18.m. in the ſixed, which reduced into *Time*, by allowing to every degree 4. minutes makes 37. minutes of time: ſo the *Sunne* was due *Eaſt* that day 37. minutes after 6. in the morning, or due *Weſt* 37. minutes before 6. in the afternoone.

The *Inſtrument* not removed, you have the time of the *Sunnes* being *Eaſt* or *Weſt* for any other *Altitude*: for right againſt the *Suns Altitude* in the moveable is the degree of time that the *Sunne* comes due *Eaſt* or *Weſt* in the fixed.

Or if the declination of the Sunne bee knowne. Bring the *Tangent* of 45. in the moveable unto the *Tangent* of the *Latitude* in the fixed (if it bee greater than 45. gr.) ſo right againſt the *Tangent* of any *Declination* in the moveable is the degree of time amongſt the *Sines* in the fixed, that the *Sunne* or *Starre* will bee due *Eaſt* or *Weſt* according to that declination; but if the *Latitude* be leſſe than 45. gr. then bring the *Tangent* of the *Latitude* in the moveable nnto the *Tangent* of 45. gr. in the fixed, ſo right againſt the *Tangent* of the *Declination* in the moveable is the degree of time in the fixed amongſt the *Sines*. Thus if the *Latitude* were 70. bring the *Tangent* of 45 unto the *Tangent* of 70. in the fixed, ſo right againſt the *Tangent* of the *Suns Declination* in the moveable admit 23.gr.30.m. is the ſine of 9. gr. 6. m. the *Inſtrument* not removed, you have the time of the *Sunnes* comming *Eaſt* or *Weſt*, for any other *Declination*, for right againſt the *Declination* in the moveable are the degrees of time in the fixed.



But if you move the moveable ſoſtly along, as the *Tangent* of 45. in the moveable paſſeth by the *Tangent* of any *Latitude* in the fixed, ſo the degrees of *Declination* in the moveable paſſeth by their degrees of time in the fixed, amongſt the *Sines* at what houre any ſuch degrees are due *Eaſt* or *Weſt*, untill the *Tangent* of 45. in the moveable bee oppoſite unto 45. gr. in the fixed: for then as the *Tangent* of any *Latitude* leſſe than 45. in the moveable paſſeth by the *Tangent* of 45. in the fixed, ſo any degree of *Declination* in the moveable will ſhew his degree of time amongſt the *Sines* in the fixed, that the *Sunne* is due *Eaſt* or *Weſt*.

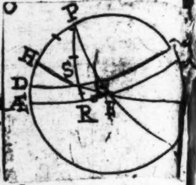
This *Propoſition* of finding the houre of the *Sunnes* being *Eaſt* or *Weſt*, may ſerve to great uſe both on *Sea* and *Land*, in rectifying of *Glaſſes*, *Watches*, or ſuch like, to keepe and *Regulate* the account of *Time*.

In Aſtronomie.

Pro. 5. *To finde the time of the Sunne Riſing or Setting in any Latitude, the Sunnes declination knowne.*

Conſtructio. BRing the *Tangent* of 45. gr. in the moveable unto the *Tangent* of the *Latitude* in the fixed (if it be under 45. but if the *Latitude* be above 45. then bring the *Tangent* of the Complement of *Latitude* in the moveable unto the *ſine* of 90. in the fixed.) So againſt the degree of *Declination* amongſt the *Tangents* in the moveable, is the degree of the *Aſcentionall difference* among the *Sines* on the fixed.

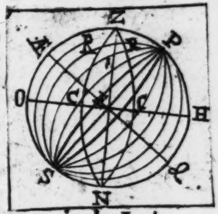
Declaratio. So if the *Latitude* were 20. gr. and the *Declination* were 10. gr. Bring the *Tangent* of 45. gr. in the moveable unto the *Tangent* of 20. gr. in the fixed, ſo againſt the *Tangent* of 10. gr. in the moveable is 3. gr. 41. m. amongſt the *Sines* in the fixed, which being reduced into time, makes neere 15. m. and this added unto 6. (if the *Sun* have South declination, gives the *Sunne* Riſing to be a quarter paſt 6. and that 15. minutes taken from 6. gives the *Sunnes* ſetting: But if the *Sunne* have North *Declination*; in ſtead of *Addition*, uſe *Subſtraction*, &c. The *Inſtrument* not removed, you may at one inſtant have the difference of *Aſcention* for any *Declination*, for right againſt the *Declination* in the moveable is the difference of *Aſcention* in the fixed. Or contrarily, the difference of *Aſcention* knowne, you have the *Declination* anſwerable unto it: In like manner may you worke for any *Starre*. Or you may ſpeedily compare the longeſt day of any two, three, or more places by knowing their *Latitudes*, for having rectified the *Inſtrument* according to the former directions, right againſt the *Tropicall* point in the moveable, *viz.* the *Tangent* of 23. gr. 30. m. is the *Sine* of the greateſt aſcentionall difference in the fixed for that *Latitude*; by which according to the former directions you may have the *Sunne* ſetting, this doubled as before gives the longeſt or ſhorteſt day for that place. Hence for *Practice*, if you move the moveable ſoftly along, as the *Tangent* of 45. gr. in the moveable, paſſeth by the *Tangent* of any degree of *Latitude* in the fixed, ſo the *Tropicall* point in the moveable, will paſſe by the *Sine* of the greateſt difference of *Aſcention* in that *Latitude*.



So as 45. paſſeth by the Latitude of	G.	The Tropicall point, viz. 23. gr. 30. m. will paſſe by	G.	M.	The greateſt difference of Aſcenſion for thoſe Latitudes.
	25		11.	41	
	30		14.	32	
	35		17.	43	
	40		21.	24	
	45		25.	47	
	50		31.	12	
	55		38.	23	
	60		48.	51	
	65		68.	42	

Pro. 1. *To finde the diſtance of the houres, in horizontall plaines for an oblique Sphære.*

Conſtructio. BRing the *Tangent* of 45 gr. in the moveable unto the *ſine* of the *latitude* in the fixed, ſo right againſt the degrees of the houres, in a right *Sphære* amongſt the *Tangent* in the moveable under 45. gr. are the degrees of the diſtances of the *houres*, from 12. amongſt the *Tangents* on the fixed for an oblique *Sphære*, but if the degrees of the houres bee more than 45. then right againſt the *Tangent* of thoſe degrees in the fixed, are the degrees of the *houre* diſtances in the moveable.



☞ Note, that the *houres* in a right *Sphære* are equall, the one unto another, viz. 15. gr. for one houre, 30. gr. for two houres, 45. gr. for three houres, &c. hence here after they are called equall houres, &c.

Declaratio. So if the *Latitude* were 51. gr. 30. m bring the *Tangent* of 45 in the moveable unto the *ſine* of 51. gr. 30. m. in the fixed, ſo right againſt 15. gr. in the moveable amongſt the *Tangents* is 11. gr. 50. m. in the fixed amongſt the *Tangents*, and ſo much is the diſtance of the houre of 1. or 11. from 12. in the *Latitude* of 51. gr. 30. m. The Inſtrument not removed you may have any other houre diſtance, halfe houres, quarters, &c.

For right againſt thoſe equal houres, viz.	Are the unequal houre diſtances, viz.	For the houre of
15	11. gr. 50. m.	1 or 11
30	24. 20	2 or 10
45	38. 03	3 or 9
60	53. 35	4 or 8
75	71. 05	5 or 7
90	90. 00	6 or 6

By inverting this, you may trie for what Latitude ordinary pocket dialls are made, knowing the diſtance betweene the houre of 11. and 12. for if you bring the Tangent of 15. gr. in the moveable unto the Tangents of the diſtance in the fixed, right againſt the Tangent of 45. gr. in the moveable is the ſine of the Latitude in the fixed.

Pro. 2. *To finde the diſtance of the houres for a direct ſouth Dyall in an oblique Sphære.*

Conſtructio. This differeth a little from the former, only, here bring the *Tangent* of 45. gr. in the moveable unto the *ſine Complement* of the *Latitude* in the fixed, ſo right againſt the *Tangent* of the degrees of the equall *houres*, are the Tangents of the degrees of the *houre* diſtances in the oblique *ſphære*.

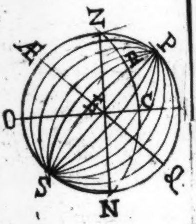
Declaratio. So if the *Latitude* were as before 51. gr. 30. m. bring the *Tangent* of 45. gr. in the moveable, unto the *ſine* of 38. gr. 30. m. in the fixed; ſo right againſt the *Tangent*.

Of thoſe degrees, viz.	Are the degrees of the houre diſtances, viz.
15	9. gr. 28. m.
30	19. 45
45	31. 55
60	47. 10
75	66. 42
90	90. 00

Now if you move the moveable ſoftly along as the *Tangent* of 45. gr. paſſeth by the *ſine Complement* of any *Latitude*, ſo the degrees of the equall *houres*, will ſhew the degrees of the unequal houre diſtances, in compariſon of one *Latitude* to another. This may be otherwiſe repreſented in this fundamentall *Diagram*. if EZ. and EH be divided out of the Table of naturall *Tangents*, ſo that each *Radius* repreſent 90. gr. and ſo to move upon E, then may you place H to P, and as you move H from P to increaſe in Latitude, ſo the meridians paſſing by E H will ſhew the houre diſtances in a Horizontall plaine, and the houre diſtances in E Z for a verticall plaine, and this kinde of projection and motion may ſerve to other excellent purpoſes, &c.

Pro. 3. *Knowing the Declination of a verticall plaine, and the latitude of the place, to finde what Angle the Axis makes with the plaine, commonly called the height of the ſtile.*

Conſtructio. BRing the *Sine* of 90. in the moveable unto the *ſine Complement* of the *latitude* in the fixed, ſo right againſt the *ſine Complement* of the *Declination*, in the moveable, is the degree of the *ſtiles* height amongſt the *ſines* in the fixed.



The *Inſtrument* not removed, you may at one *Inſtant* ſee the *ſtiles Altitude* for all *Declinations* in that *Latitude*: for right againſt the *Complement* of the *Declination* in the moveable, is the *ſtiles height* in the fixed.

Declaratio. So if the *Latitude* were 51.gr.30.m. the complement of it is 38.gr.30.m. which ſeeke amongſt the *ſines* in the fixed, and bring 90. gr. to it, now if the *Declination* of the *plaine* were 10.20.30 40.50. 60.70.80.&c.

The *Complement* of thoſe are.	So right againſt theſe in the moveable are
80	37.49
70	35.48
60	32.37
50	28.22
40	23.35
30	18.08
20	12.18
10	6.12

in the fixed the *ſtiles height* anſwerable to theſe *Declinations*.

Pro. 4. *Knowing the Latitude of the place, and the Declination of a verticall plaine, to finde the number of degrees betweene the Meridian of the place, and the Meridian of the plaine, which may be called the difference of Meridians.*

Conſtructio. Bring the *Tangent* of 45.gr. in the moveable unto the *ſine* of the *Latitude* in the fixed (which admit 51.gr. 30.m.) ſo againſt this 45. [redacted] is the *Tangent* of 38.gr.3.m. in the fixed: So if the *Declination* of the *Plaine* be 38.gr.3.m. then the difference of *meridians* is 45.gr. But if the *Declination* be leſſe then this 38.gr.3.m. right againſt the *Tangent* of any degree for ſuch a *Declination* in the fixed is the degree of the difference of *meridians* in the moveable.

So if the *Declination* were	Right againſt theſe in the fixed are
35	41.49
30	36.25
25	30.44
20	24.56
15	18.54
10	12.42
5	6.23

In the moveable, the difference of *meridians* anſwerable to thoſe *Declinations*.

If the *Declination* be above 38 gr. 3. m. you may move the *Tangent* of 45. ſoftly alonge by the *Tangentiall* degrees of *Declination* in the fixed, untill 45. gr. in the moveable be oppoſite to 45. gr. in the fixed, and as it paſſeth by any *Declination*, the ſine of the *Latitude* in the fixed, will give the difference of *Meridians* amongſt the *Tangents* in the moveable. Laſtly, if the *Declination* be above 45. gr. then the *Declination* moſt be accounted amongſt the degrees of the moveable, and if you move the moveable ſoftly along: As the degree of any *Declination*, paſſeth by the *Tangent* of 45 gr. in the fixed: ſo the *Tangent* of the difference of *Meridians* in the moveable paſſeth by the *ſine* of the *Latitude* in the fixed, &c.

Pro. 5. *To finde the houre diſtances in Dyalling in a Declining plaine by knowing the former, viz. the ſtiles height, and the difference of Meridians.*

Declaratio. LET the *Declination* of a *Plaine* be S.W. 50. gr. according to the former *Inſtruction*, the *ſtiles* height would be 23. gr. 35. m. and the difference of *Meridians* 56 gr. 43. m. Now before the *houre* diſtances can be knowne which are alwayes unequall, there may be made a *Table* of equall *houres* thus.

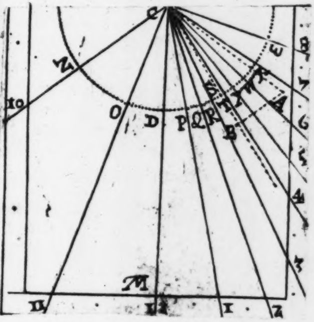
Firſt, place downe 56. gr. 43. m. the *difference of Meridians* againſt 12. as in the Table, then by adding 15. gr. unto this difference of *Meridians*, *viz.* to this 56. gr. 43. m, it makes 71. gr. 43. m. for the diſtance betweene the houre of 11. and the *Meridian* of the plane: unto this 71. gr. 43. m. adde another 15. gr. makes 86. gr. 43. m. for the *houre* diſtance betweene 10. and the *Meridian* of the *Plaine*: But for the houre of 1. 2. 3. that 15. gr. muſt be taken from the ſaid 56. gr. 43. m. ſo the *houre* diſtance of 1. is 41. gr. 43. m. the *houre* diſtance of 2. is 26. gr. 43. m. the *houre* diſtance of 3. is 11. gr. 43 m. now becauſe 15. gr. cannot be taken out of 11. gr. 43. m. take this out of that, ſo the *houre* diſtance of 4. will be 3. gr. 17. m. now unto this adde 15. gr. makes 18 gr. 17. m. for the houre of 5. then adde 15. gr. to that, and ſo proſecute the *Table* which may be called the *Table* of equall *houres* from the *Meridian* of the plaine.

10	86. 43	81. 50
11	71. 43	50. 20
12	56 43	31. 20
1	41. 43	19. 35
2	26. 43	11. 22
3	11. 43	4. 45
4	3. 17	1. 15
5	18. 17	7. 32
6	33. 17	14. 35
7	48. 17	24. 10
8	63. 17	38. 25

Now to finde the true *houre diſtances*, bring the *Tangent* of 45. gr. in the moveable unto the *ſine* of the *ſtiles* height in the fixed, viz. 23. gr. 35. ſo right againſt the *Tangent* of any equall *houre* in the moveable under 45. gr. is the *Tangent* of the true *houre* diſtance in the fixed A. But if the equall *houre* diſtance be above 68. gr. 12. m. (which is right againſt 45. gr. in the moveable) then right againſt the equall *houre* diſtance in the fixed, is the true houre diſtance in the moveable B. Laſtly, if the equall *houre* diſtances be betweene 45. gr. & 68. gr. 12. m. then move the moveable ſoftly along, and as the *Tangent* of any equall houre in the moveable paſſeth by the *ſine* of the *ſtiles* height in the fixed, ſo right againſt the *Tangent* of 45. gr. in the moveable is the *Tangent* of the true *houre* diſtance in fixed.

So the equall houre diſtances being — The true houre diſtances would be

A	3. 17	1. 15
	18. 17	7. 32
	33. 17	14. 35
B	86. 43	81. 50
	71. 43	50. 20
C	48. 17	24. 10
	56. 43	31. 20
	63. 17	38. 25



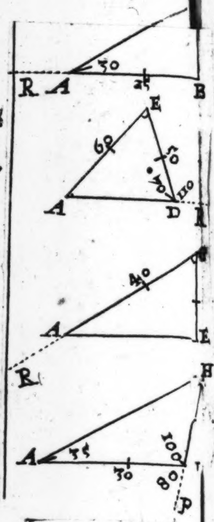
Having gotten the true houre diſtances from the Meridian of the Plaine, they may be placed againſt the houres as in the Table, and protracted thus, draw the houre of 12. C. M. and on C. deſcribe a ſemi-Circle: now ſeeing in the Table that the Meridian of the Plaine is from the houre of 12. in its true diſtance 31. gr. 20. m. protract it in the Circular Arke from D. to S. (becauſe of Weſt declination) otherwiſe contrary, and draw C. S for the Subſtiler; from this S. protract all the houres diſtances, as S. R. 4. gr. 45. m. for the houre of 3. S. Q. 11. gr. 22. m. for the houre of 2. &c. then may we draw the houre lines CN. CO. CP. CQ. CR. CT. CV. CW. CX. CΩ. and upon the ſaid C S. place the ſtile A. B. C. perpendicular to the plaine, ſo it ſhall bee fitted for the caſting of ſhadowes upon the ſaid houre lines.

Of

Præcognita.

Theoreme. 1. IF a right line fall upon a right line, or if the ſide of an Angle be augmented to make another Angle, thoſe two Angles put together are equall to two right angles, that is twice 90. or 180. gr. by the thirtenth of the firſt of *Euc.* therefore knowing one of thoſe Angles, the other is alſo knowne; So in the *Triangle* A B C augmenting the angular ſide B A to R. by the line R B and C A there is made two Angles, viz. C A B. and C A R. which together make 180. gr. and ſeeing the Angle C A B. is aſſumed to be 30. gr. neceſſarily by the ſaid thirtenth Propoſition, the other Angle C A R ſhall be 150. gr.

Theoreme 2. The three Angles of any *plaine Triangle* either *Right*, or *Oblique* by the 32. of the firſt of *Euc.* are equall to two *right Angles*, therefore one acute Angle knowne in a right *angled Triangle*, and two Angles knowne in an *Oblique Angled Triangle*, the third Angle is likewiſe knowne: hence in the right angled Triangle A B C knowing the Angle at A. 30. gr. the Angle at C moſt be 60. gr. And ſo in the Oblique Triangle A H I. the Angle at A and I put together being 135. the Angle at H muſt be 45. gr. &c.



Propoſitio. I.

In any { Right Angled / Oblique Angled } *Triangle*, knowing { One *Acute Angle*, and a ſide oppoſite to either of the *Angles*, or the *Hypotenuſæ*, and one ſide / Two *Angles*, and a ſide, or two ſides and one *Angle* oppoſite to either of thoſe ſides } to find the reſt.

Axiome 1. *The Axiome for the reſolution of this propoſition is thus.*

The ſides in all ſuch Triangles, beare proportion the one to the other, as the ſines of their oppoſite Angles doe. Or the ſines of the Angles are directly proportionall to their oppoſite ſides, by the ſeven & twentieth of the firſt Booke of *Regiomontanus*, the thirtenth Chap. of the 1. of *Copernicus*, and by the ſecond *Axiome* of the third booke of *Pitiſcus*.

That is, the ſide A B (in the firſt Triangle) is in proportion to B C, as the ſine of the *Angle* at C is to the *ſine* of the *Angle* at A, or as A B. to A C. ſo the *ſine* of the *Angle* at C. to the *ſine* of the *Angle* at B. which are the oppoſite *Angles* of thoſe ſides: Againe in the oblique *angled Triangle* A D E, as the ſide A E is to E D, ſo is the *ſine* of the *Angle* at D. to the *ſine* of the *Angle* at A, or as the *ſine* of the *Angle* at H, (In the fourth *Triangle*, is to the *ſine* of the *Angle* at A, ſo is the ſide A I, to the ſide I H, &c.

☞ And here note generally, that in the reſolution of ſuch *Triangles* there is three things given (as afore ſaid) by which a fourth is found, according to the method of the *Golden Rule*. But the diſpoſing of the ſaid three *termes*, is primarily, and principaly to be conſidered.

Of

How to diſpoſe the three Termes knowne in any of the former Triangles fit for operation.

First,if a ſide be required in a right,or oblique *Triangle*, & a ſide be knowne, and the *Angles* oppoſite to thoſe ſides bee alſo knowne: the *Angle* oppoſite to the ſide knowne ſhall have the firſt place of the *Golden Rule*, and the *Angle* oppoſite to the ſide required may have the ſecond place of the *Golden Rule*, and the ſide knowne the third place.

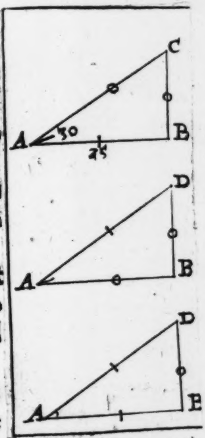
Secondly, if an *Angle* be required, and an *Angle* knowne with the ſides oppoſite to thoſe *Angles*, then the ſide oppoſite to the *Angle* knowne ſhall have the firſt place of the *Golden Rule*, the ſide oppoſite to the *Angle* required may have the ſecond place of the *Golden Rule*, and the *Angle* knowne ſhall have the third place: the diſpoſing of the *Termes* thus conſidered, the *Angles* have reference to the *Circle* of *Sines* upon the *Ring*, and the ſides to the *Circle* of *Numbers*.

Example. Let the ſide BC. in the *Rect-Angle Tri-Angle* be required, knowing the ſide AB. 25. and the *Angles* at A and C. 30. gr. and 60. gr. therefore by the former. As the *Sine* of the *Angle* at C. 60. gr. to the *Sine* of the *Angle* at A. 30. gr. ſo the ſide AB. 25. to the ſide BC. 14. and 43. 100. and ſo of the reſt.

The conſtruction by the Ring is thus.

Bring 60. gr. amongſt the *Sines* in the moveable to the *Sine Complement* of it in the fixed, *viz.* 30. gr. ſo right againſt AB. 25. in the *Circle of Numbers* in the moveable is 14. and 43. 100. in the fixed. But if the ſide AB. had beene any other number, you might inſtantly have the ſaid BC. according to the ſame proportion.

☞ Here note generally, that if the two firſt *Termes* be upon the Circle of *Sines*, the other two termes are then upon the Circle of *Numbers*, vel contra. *



☞ Note further, that in all *Trigonometrie*, the termes or parts given either *Angles* or ſides, are noted with a ſmall ſtroke of the Pen thus —— and the *Termes* or parts required either in the *Angles* or in the ſides, thus O. ſo the ſides AB. AD. AE. [illegible]. with the *Angles* at A. are given the ſides AC. CB. AH. and [illegible]. and the *Angles* at E. and G. are demanded; now the mutuall proportion of theſe parts one unto another, is according to the former *Axiome*; by which infinite propoſitions may bee reſolved of admirable conſequence, lying under the habit of ſome one of thoſe whoſe excellent uſe in ordinary *Practicall things*, I will *illuſtrate* in ſeverall kinds by ſundry propoſitions; firſt, In *Dementions*; ſecondly, in *Fortification*; thirdly, in *Navigation*; fourthly, in *Dyalling*, as followeth.

Vpon Plaine Triangles in Dementions.

Vſe I.

How to meaſure an Inacceſſible height ſcituated upon a Hill, the Practice being not upon a Plaine.

THe *example* upon this I will take from mine owne *obſervations* which I made upon one of the goodlieſt *Hills* in this Kingdome, which belongs to Sir *Richard Newport* in *Shropſhire*, called the *Wreaken*, not farre from *Shrewsbury*, which *Hill* I found to be neere 6. miles and a halfe in Circuit, and in the *Perpendicular* height 995. foot, as followeth.

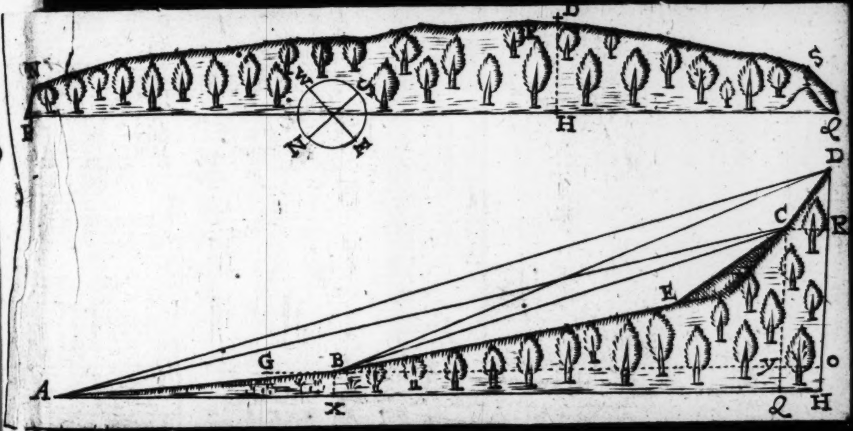
Declaratio. Let the figure P. Q. S. N. repreſent the body of the *Hill*, and A B B C D a part of the ſide of it, now admit in the ſide of the Hill as at C, be a *ſpring* of water: and let a *Well* be ſunke from the Top of the Hill at D to be levill with the *ſpring* C, *viz.* at R: here it may be demanded how deepe this *Well* may be ſunke, *viz.* D R, how farre it is from the *ſpring* C, to the botume of the *Well* R, and how farre it is from the ſaid *ſpring* C, to the Top of the *Hill* D.

Conſtructio. Firſt, with conveniencie I made choiſe of a *Station* at A, and there rectified my *Inſtrument* upon his *Stay*, or *Reſt*, from thence I cauſed to be meaſuredto B 20. *Chaines*, and at B I cauſed another *Stay* or *Reſt* to be erected of the ſame height that the former at A was: Then loking from A to B. by the *Sights* of the *Inſtrument*, I found the *Angle* of Aſcent B A X. 4. gr. 44. m. and ſo I had the rectangled triangle A X B. in which A B was knowne 20. *Chaines*, or 1320 *foot* with the *Angle* at A 4. gr. 44. m. and therefore the *Angle* at B by the ſecond *Theorem Pagr.* 64. is 85. gr. 16. m. and the *Angle* at X by the ſame is 90 gr. and this is oppoſite to the ſide knowne, *viz.* A B. 20.

Now according to the Rule of operation by the *Ring Page.* 65. if the *Sine* of 85. gr. 16. m. in the moveable be brought to the *ſine* of 4. gr. 44. m. in the fixed, right againſt 20. in the *Circle of Numbers* in the moveable is 1. *Chaine*, and 65. 100. of a *Chaine* in the fixed, which according to *Page* the ninth is 108 *Foote*, and 9. tenth. this ſhewes that the ſtation at B was ſo many *Foote* higher, than that at A. By the ſame *Rule* A X. would be found to be 19. *Chaines*, and 93. hundreths of a *Chaine*, or 1315. *Foote*, and 5. tenths, thoſe two *dementions* I firſt ſought out.

Secondly, before I removed from A. I obſerved the *Angle* C A H. which I found to be 12. gr. 8. m. and alſo the *Angle* D A H. which was 15 gr. 55. m. thoſe *Angles* I noted downe, and then going from A to B. there I rectified my *Inſtrument* as I did formerly at A. and there I obſerved the *Angle* C B Y, which I found to be 16. gr. 45. m. and the *Angle* D B O. to be 22. gr. 12. m. thus for the obſervation.

But according to the firſt *Theoreme* Page. 64. if particularly thoſe *Angles* be taken from 180. gr. leaves the angle G B C. 163. gr. 15. m. and the angle G B D. 157. gr. 48. m. unto theſe ſeverall Angles, Adde the Angle B A X. 4. gr. 44. m. ſo have you the obtuſe angle A B C. 167. gr. 59. m. And the obtuſe Angle A B D. 162. gr. 32. m. And ſeeing formerly that the Angle C A H was 12. gr. 8. m. and the Angle D A H was 15. gr. 55. m. From either of thoſe Angles I ſubtract the Angle B A X, *viz.* 4. gr. 44. m. leaves the Angle C A B. 7. gr. 24, and the Angle D A B 11. gr. 11. m. By which in the oblique *Triangle* A B D, and A B C are knowne in each of them two Angles, and ſo conſequently by the aforeſaid ſecond *Theoreme*, Pag. 64. The other Angles are alſo knowne (*viz.*) the Angle A C B, 4. gr. 37. m. and the Angle A D B 6 gr. 16. m.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NOw by the afore going firſt *Axiome* ſeing that in the *Triangles* A B D, all the Angles are knowne, and one ſide to wit A B. 20. the ſide A D may be alſo knowne.

Conſtructio. Bring the *ſine* of the Angle A D B 6.gr. 16.m. in the moveable unto the *ſine* of the Angle A B D. 162.gr. 31.m. (that is to the *Sine* of the Complement of that Angle, viz. 17.gr. 29.m.) in the fixed, ſo right againſt 20. in the moveable amongſt the *Numbers* is 54. *Chaines* and 93. 100. ths. in the fixed, which in feete is 3625. and 6. tenths. and ſo farre it was from the eye at A to the top of the *hill* at D.

Thirdly, in the *Rect angled Triangle* A H D knowing as afore ſaid the Angle D A H 15.gr. 55.m. by the ſecond *Theoreme* Page 64. all the other Angles are knowne, viz. A D H 74. gr. 4. m. A H D 90. and ſeeing by the laſt worke that A D was found to be 54. Chaines, and 93 100ths. the other parts of the *Triangle* by the afore ſaid *Axiome* will be likewiſe knowne. For the Inſtrument not removed the *Sine* of 90. is againſt the *Sine* of 15. gr. 55. m. and right againſt 54. and 93. 100ths. is 15. *Chaines*, and 07. 100ths. of a *Chaine*, which by Page the ninth makes 995. foote the higth of the *hill*. In like manner may you finde the other ſide of the *Triangle* viz. A H, that is from the eye under the top of the *hill*, viz. 52. *Chaines*, and 82 hunderths, or 3486. foote, and 4. tenths.

Fourthly, in the *Oblique Triangle* A B C. all the Angles are knowne (as afore) with the ſide A B, and therefore the ſide B C would be found to bee 32. *Chaines*, or 2113. foote.

Fifthly, in the rect angled *Triangle* B Y C the Angle C B Y was formerly knowne to be 16.gr. 45.m. the *Complement* of which is the Angle B C Y. 73. gr. 15.m. and the ſide C B was formerly found to be 32. *Chaines*. therefore by the afore ſaid firſt *Axiome* of plaine *Triangles*, the other ſides of the *Triangle*, viz. B Y. will be found to be 30. *Chaines*, and 65 hunderths. or. 2023. foote, and 3 tenths, and the ſide C Y. to be 9. *Chaines*, and 23 hunderths, or 608. foote, and 9. tenths.

Sixthly, ſeeing B X. is equall unto Y Q. unto the ſaid C Y. 608. foote, and 9. tinths, add. B X. formerly found, viz. 108. foote, and 9 tinths makes Q C. 717. foote, and 8. tenths. but this Q C. is equall to H R. which taken from the higth of the whole hill D H, viz. 995. foote leaves D R. 277. foote, and 2. tenths, the depth of the well.

Seventhly, for as much as B Y was found to be 2023. foote, and 3. tenths. which is equall to X Q and A X being as before 1315. foote, 5. tenths, thoſe two put together makes A Q 3338. foote, and 8. tenths, which taken from A H, which was formerly found to bee 3486. foote, 4. tenths leaves Q H. 147. foote. 6. tenths, which is equall to C R. the diſtance betweene the ſpring C, and the botome of the well R.

Eightly, and laſtly knowing D R. 277. foote, and 2. tenths, and C R 147. foote, and 6. tenths C D is found to bee 313. and 8. tenths, according to the firſt Propoſition, Page 19ths. the example being the ſame with the ſecond Propoſition: thus for the *Inſtrumentall* way: ſuch as deſire to examine the worke by numbers may procede by the Notes here under ſpecified.

In Triangl	Data	Quæritur
AXB	B A X 4.gr. 44.m. A B. 1320.	A X. 1315. & 5. 10ths. B X. 108. and 9. 10ths.
ABD	A B. 1320. B A D. 11.gr. 11.m. 43.s. ABD. 162.gr. 31.m. 45.s.	A D. 3625. & 6. 10ths.
AHD	D A H. 15.gr. 55.m 43.s. A D. 3625. and 6. 10ths.	D H. 995. A H. 3486. & 4. 10ths.
ABC	C A B. 7.gr. 24. m. A B C. 167.gr. 59. A B. 1320.	B C. 2113.
BYC	C B Y. 16.gr. 45.m. B C. 2113.	B Y. 2023. & 3. 10ths. C Y. 608. & 9. 10ths.
CRD	R D. 227. and 2. tenths. C R. 147. and 6. tenths.	C D. 313. & 8. 10th

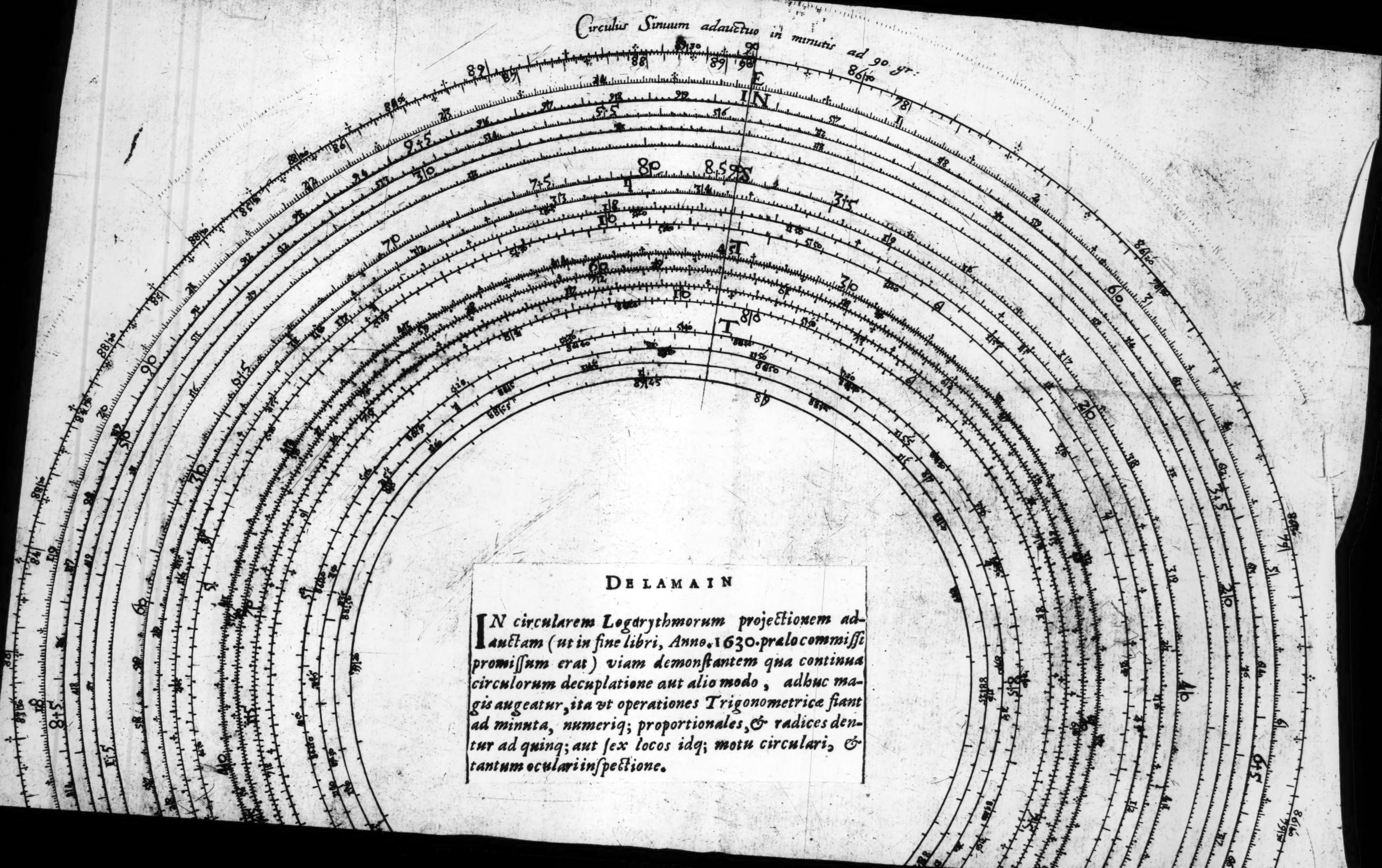
Upon his Ring.

AS in a ſecret *Circle* wrapt lies natures *myſteries*,
Which time brings forth, and induſtry makes plaine to all mens (eyes,
So that what erſt was hard to finde, at length is wrought with eaſe,
Rules of *Proportion*, the *Roots Extraction*, and theſe
With ocular inſpection now: Alſo *Triangles* Plaine
And Sphæricall; for *Queſtions* ſoone an *Anſwer* to obtaine;
That it makes *Art* laugh his quickneſſe to ſee, then uſe this *Ring*,
The *Circle* where, hid *Arts* lie now themſelves diſcovering.
If after times ſhall ſeeke more eaſe than in this eaſineſſe
By *Inſtrument*, he makes *Art* lame, with eaſes great exceſſe.

By a Friend.

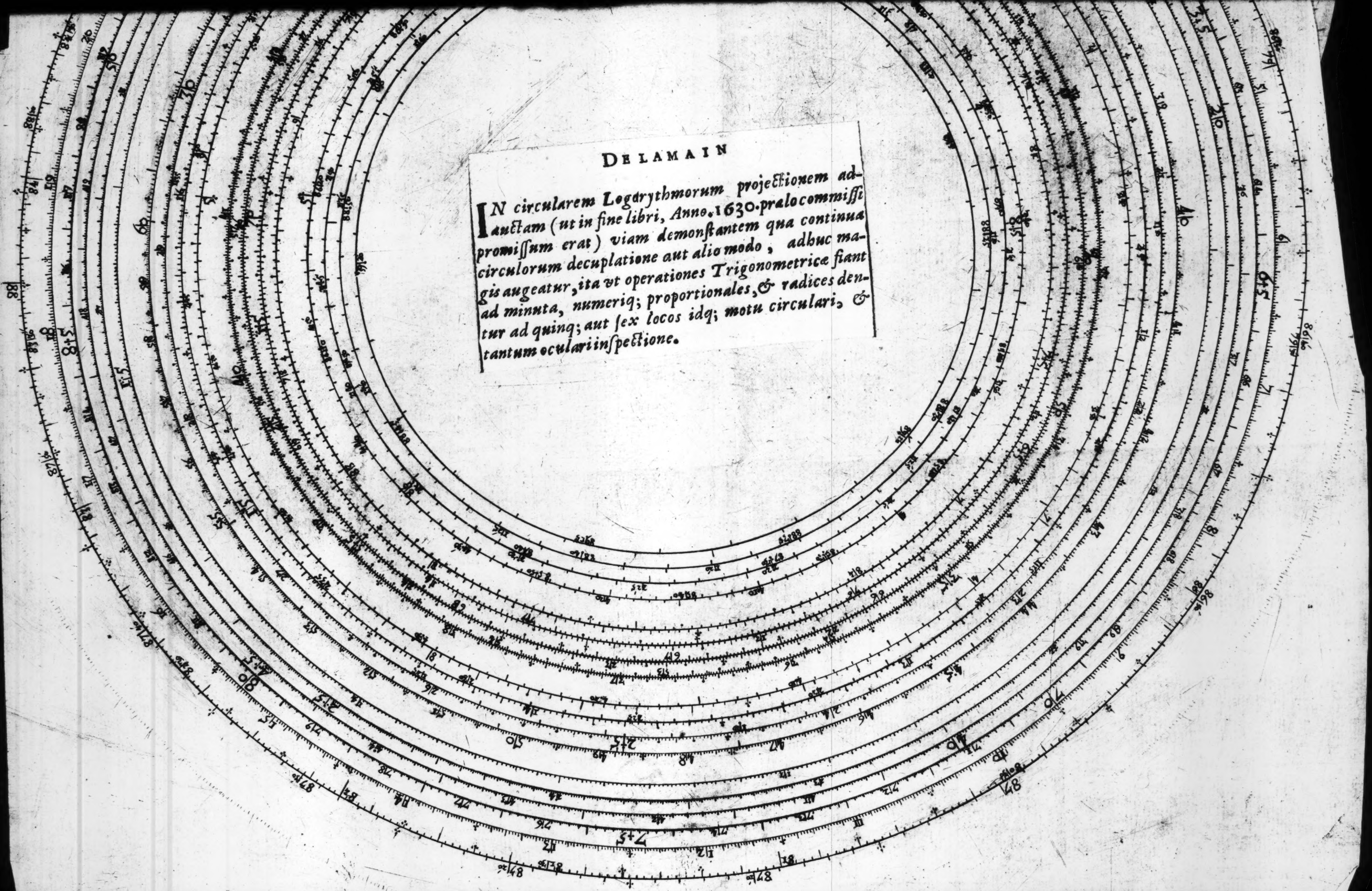
THe *Ægyptian Sages*, who were wont to ſing
In the *Hiroglyphicks*, their Philoſophy;
Portrai'd the yeare in ſemblance of a *Ring*,
Cauſe ſo the yeare round in it ſelfe doth lie.
Thy *Mathematicke Ring* is more profound,
A world of Art lies in little Round.

FINIS.



DELAMAIN

IN circularem Logarythmorum projectionem adauctam (ut in fine libri, Anno. 1630. pralo commiſſi promiſſum erat) viam demonſtantem qua continua circulorum decuplatione aut alio modo, adhuc magis augeatur, ita vt operationes Trigonometricæ fiant ad minuta, numeriq; proportionales, & radices dentur ad quinq; aut ſex locos idq; motu circulari, & tantum oculari inſpectione.



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How to operate, in the finding of Proportionalls by my Logarythmall Projection of Circles inlarged, eyther by a mooveable and fixed Circle, or by a ſingle Projection, with an Index at the Peripheria, or Center.

THe way of operation is drawne from the nature of *Proportionall Logarythmes, that as they keepe equall differences, ſo in a lineary or Circular Inſtrumentall projection of theſe Logarythmes, Proportionall numbers ſhall alwayes have equall diſtances,* which as a *fundamentall ground* may ſerve to the more learned both for a full *demonſtration*, and direction in *operation*.

But to make things more obvious, & to remoove ſuch ſcruples as may ariſe in working by this *Projection*; the numbring of the *Circles* eſpecially is to be conſidered, that is either by *augmentation* or *diminution*, in *continuation* or *diſcontinuation*, and this hath relation to the line of *Conjunction E.T.* which ſheweth the breaches of the *Circle*, or the uniting or continuing of the parts: which multiplicitie of *Circles*, muſt be conceived to be but the parts of one *Circle* (as before amply in the *Epiſtle* to the *Reader* was ſpecified touching this *projection*) and ſo continued or diſcontinued, by aſcending or deſcending on this or that ſide of the line of *coniunction*, as by the ſucceſſion of the *Graduations*, or *diviſions* in thoſe *Circles* is moſt evident and conſpicuous: this well premiſed:

Conſtructio. Bring the firſt number in the *mooveable*, to the ſecond number in the *fixed*, and marke the ſeverall revolutions or *Circles* betweene them aſcending or deſcending; for then the fourth *Proportionall* is had on the *fixed*, right againſt the third number in the *mooveable* by the ſame number of *revolutions* or *Circles* aſcending or deſcending, as was betweene the firſt and ſecond *numbers*.

So if the line of *coniunction* on the *mooveable*, be on the right or left ſide on the line of *Coniunction* on the *fixed*, and the firſt and ſecond *numbers* be betweene them, and alſo the third, or all theſe three *numbers* be not betweene them, the fourth *number* or *proportionall* is had without any conſideration, but onely by the ſame number of *Circles*, as was betweene the firſt and ſecond *numbers*. But if the third *number* be on the otherſide of the line of *Coniunction*, and that the *Proportionalls*

tionalls did augment, or diminiſh, the ſame number of *Circles* or *revolutions* accounted aſcending or deſcending from the third *number*, will likewiſe ſhew the fourth *proportionall* required.

Or without conſidering the abſolute revolutions, you may operate by the difference of Circles noted on the ſingle Index thus.

Bring the *firſt number in the mooveable* unto the *ſecond number* in the *fixed*, and marke the difference of *Circles*, eyther aſcending or deſcending betweene them; then whenſoever in operation the ſayd *firſt* and *ſecond number*, and alſo the *third* number are neyther of them betweene the *lines of Coniunctions*, or all of them are betweene them, then the *fourth proportionall* is had in the *fixed* right againſt the *third number in the mooveable*, by the ſame difference of *Circles* aſcending or deſcending, as was betweene the *firſt* and *ſecond numbers*.

But if the *line of conjunction* on the *moveable*, bee on the right ſide of the *line of conjunction* on the *fixed*, and the *firſt number* bee in a lower Circle then the ſecond and	bee not betweene the *lines of Conjunctions*, but the third,	then the fourth proportionall is in one *Circle*	*more*	then the difference of *Circles* betweene the *firſt* and *ſecond numbers*. But if the firſt number bee in a higher *Circle* then the ſecond, then the difference more will bee leſſe, and that which is leſſe more.
	be betweene the *lines of conjunctions* & not the *third*		*leſſe*	

Contrarily, if the *line of Conjunction* on the *mooveable* bee on the left ſide of the line of *Conjunction* on the *fixed*, the operation is the converſe of the former.

The like may be obſerved in operation by the *ſingle Projection inlarged*, with a double *Index* to move on the *Peripheria*, or *Center* of a *Circle*, if in ſtead of moving one number to another, you extend the feete of the *Index*, as followeth.

An

An Example of the operation upon the Projection of the Circles of my Ring inlarged, according to the concluſion of my firſt Booke, in a Scheme or Inſtrument where the Circles of Numbers, Sines, and Tangents are decuplated, the diameter being but 18. *Inches onely.*

SVppoſe the *Sunne* being in the *Tropicke*, and his greateſt *Amplitude* were required in the *Latitude* of 66.gr.29.m. The common *Rule* to operate which, is thus delivered.

As the *Sine* complement of the *Latitude*, is unto the *Sine* of the *Suns declination* propoſed, ſo is the *Sine* of 90.gr. unto the *ſine* of the *Suns Amplitude* required; the *Diagramme* and *Demonſtration* of which, ſee Pag 57. and the *Inſtrumentall* operation may be thus.

Conſtructio. Place one of the edges of the *Index* unto the *ſine* of 23. gr. 31.m. (the Complement of the *Latitude* propoſed) and extend the other edge unto the *Sine* of 23.gr.30.m. (the *Suns* greateſt declination) then moove the edge of the firſt *Index* unto the *Sine* of 90.gr. ſo the edge of the ſecond *Index* ſhall give the fourth proportionall ſought for.

But becauſe the anſwer in this *Propoſition* falls neare the *ſine* of 90. gr. (where the degrees are ſmall, and the graduations cloſe) the anſwer is not ſo exactly diſcerned in the minuts as if it were larger. To ſupply which, or ſuch like as may fall out in *Practiſe*, I have continued the *Sines* of the *Proiection* unto two ſeverall *revolutions*, the one beginning at 77.gr.45.m. 6.ſ. and ends at 90.gr. (being the laſt *revolution* of the *decuplation* of the former, or the hundred part of that *Proiection*) the other beginning at 86.gr.6.m.48.ſ. and ends at 90. gr. (being the laſt of a ternary of *decuplated revolutions*, or the thouſand part of that *Proiection*) and may bee thus uſed.

Lay the edge of the *Index* upon the former 23. gr. 31.m. and marke what equall parts in the *Circle* of equall parts are interſected thereby, which will be 0099. Place alſo the edge of the *Index* upon 23.gr. 30.m. which will cut in the *Circle* of equall parts 0069. Then take ten times the diſtance of theſe two numbers in the *Circle* of equall parts betweene the feete of the *Index* by decuplation, that is, place one foote of the *Index* upon 99. and extend the other foote unto 69. ſo the edge of the firſt foote being placed on the *ſine* of 90.gr. the edge of the ſecond foote will point out accuratly 87.gr.54.m.and ſuch is the *Amplitude* in the *Latitude* of 66.gr.29.m.the *Sun* being in the *Tropicke* aforeſaid.

Againe,admit that in the *Latitude* of 51.gr.32.m.the *Suns* place were required by knowledge of his *Meridionall Altitude*, which ſuppoſe was found to be 61.gr.57.m $\frac{1}{6}$. Now the common *Axiome* according to the *Diagram* of Pag.56. grounded on *Mathematicall* doctrine to operate which is: As the ſine of the *Suns* greateſt *declination*,*viz*.23.gr.30.m.is unto the *ſine* of 90.gr.ſo is the *ſine* of the *Suns Declination* given *viz* 23.gr.29.m $\frac{1}{6}$. unto the *ſine* of the anſwer. Therefore *Inſtrumentally* open the *Index* unto the firſt two tearmes propoſed,and place the edge of the firſt foot upon the third *number*, ſo the edge of the ſecond foote ſhall give the fourth proportionall required.

But for as much alſo as the anſwer in this doth fall amongſt the ſmall diviſions neare the ſine of 90.gr.in the *decuplated Proiection*,we may ſupply that contraction according to the former, but truer by the largeſt augmented *Circle* of *Sines*, to wit, that which is the thouſand part of its *Proiection*,thus ; Lay one of the edges of the *Index* upon the *ſine* of 23 gr.30.m. and marke the number of equall parts which it cuts in the *Circle* of equall parts,viz. 70. lay alſo the edge of the *Index* upon 23.gr.29.m. $\frac{1}{6}$. and it cuts likewiſe in that *Circle* 64. then take a *hundred times* the diſtance of theſe two numbers in the *Circle* of equall parts betweene the feete of the *Index*, that is, place one of the edges of the *Index* upon 70.in the *Circle* of equall parts by *Centuplation*,and extend the other edge unto 64 (for the *Decuplating*,and *Centuplating* of the equall parts, doe naturally without trouble repreſent themſelves in this projection) ſo the edge of the firſt *Index* being placed at the ſine of 90.gr.the other edge will accuratly point out 89.gr.5.m. the *Suns* place at the time obſerved, and ſo in like manner for other operations.

Nam quam in minoribus circulis æqualium partium diſtantiam proportionales habent : eandem in circulis adauctis proportionales retinebunt.

Thus I have here now produced to a publike veiw my *Proiection of Logarythmes in'arged* by way of *decuplating*, *Centuplating*, &c. of the *Circles*, as I promiſed at the *Concluſion* of the firſt publiſhing of this Invention, to the world,and have in ſome meaſure ſhewed the *Accurate* working of *Trigonometry* by it,neare the *Sine* of 90.gr. where difficulty ſeemes to be;for being thus inlarged the greatneſſe of a *degree* betweene the *ſine* of 89.gr. and the *ſine* of 90 gr.is more then 4.*Inches*, and if I ſhould have inlarged the *Circle of Tangents* according to the *Sines*,the capacity of a *minute* at 45.gr.would bee more than 8.*Inches* which inlargement amongſt the degrees which falls neare the Sine of 90.gr.doth operate as true (according to the former *Diameter* but if 18. *Inches*) as if Mr. *Gunters* excellent Lines were extended or projected unto 4000. *foote*. And if I ſhould frame a Ring as is ſpecified in the concluſion of my firſt publication of this *Invention*, being of two *yards diameter*, and apply it to *Aſtronomicall Calculations*, no doubt I might ſhew a way (or others may eaſily) to compendiate many operations therein; and ſufficiently cleare my intentions then delivered touching the *Proſtaphereſes of the motions*; though ſome *one* in contempt of my good indevours divulged after it came to the worlds view, it could not bee done, nor poſſibly a minute expreſſed at the ſine of 90 gr. (as I have now produced it) thereby endeavoring to annihilate my labours and to ſpread an unſavory rumor, which might ſeeme to argue not onely his ignorance of my *intentions*, but alſo of the manner of extending and inlarging of that *invention* (though now given out that I had that *invention* from him:) But touching ſuch applications to prove my aſſertion hereafter, as *God* ſhall give life, & ability of *health*: and let a further time bring them to *maturitie*, that my Iealous oppoſite may bee no more miſtaken with a ſuſpected *untimely birth*. I confeſſe theſe ſingle *Circles* before, were ſomething *untimely*, in regard of theſe which are of fuller *growth*, and yet may have further application, without wayting his time to perfect them.

Courteous Reader

H*Itherto the* world *hath beene abuſed as well as my* ſelfe, *with a falſe* Rumor (*raiſed by ſome rude ignorant* tongue) *that my* Invention *both of* Ring *and* Quadrant *was got, or borrowed, or ſtollen (even as they pleaſe to miſcall it) from another* Man, *by the ſight of a* Letter, *by ſome private* Conference *by* ——— *J know not what meanes (nor they neither) but onely by their malicious phancy: which how true, how juſt it is, that the* world *and my* ſelfe *may have our* right, *and they the* ſhame, *by this following juſt defence and future event, J hope thou mayeſt fully be enformed. I did not intend to take this courſe, but ſought* peace *and my* right *by a private and* friendly way; *but failing of it my good intentions* ſcorned *and* ſlighted; *J deſire all may now* Iudge *who is in fault; and let this enſuing diſcourſe be my* Plea.

To the Reader

HOw undeſervedly oft are the ſingle and ſincere endevours of ſome men by the malevolent diſpoſition of envious detractors backbited, (wch ſometimes rebounds backe averſly upon them) not onely by bare *aſſertions*, but alſo by *injurious*, and *contumelious aſpertions*; In which kind I have not a little lately ſuffered: for having for a generall nd (more then ayming at mine owne particular) publiſhed the making & uſe of my *Horizontall Quadrant*, with my new *invention* of the *Projection* of *Logarythmes Circular* by a former booke of the uſe of it, intituled with this, *Grammelogia*, or the *Mathematicall Ring*, ſince that time I have beene deepely glanced upon, and ſcandalized both about the former and latter, theſe detractors taking away from one, and giving to another, *famouſing* ſome, and *infaming* others, which did not a little diſturbe the quiet and *Peace* which formerly I injoyed, but did alſo diſorder and ſlacke my intentions, in the publiſhing of the inlarging of the *Invention* of my *Ring*, as I promiſed to doe in the *Concluſion* of the aforeſaid *Booke* of the uſe of that *Ring*, which would ſerve as a helpe for ſuch as affect *Mathematical practiſes* for the working of *Trigonometrie* unto minuts, and to give accuratly *Rootes* and *Proportionall numbers*, unto 5. or 6. places, as is ſpecified before in the deſcription of the projection, and had ere now beene publiſhed with the excellent uſe thereof, (not out of any *Mercinary* reſpect nor interlaſed with *untruths, deluſions*, and *bumbaſt ſtuffe*, by way of *Illuſtration* if not *confuſion*) had not ſome envious *calumniators* ſtole away my intentions, in ſtealing from me my labours, by detracting from me, and aſſuming unto themſelves the inverting of the *Circles of my Ring* upon a *Plate* or *Plaine*, accommodated with an *Index* to open and ſhut at the *Center*, *when another m imitating thereof, did ſo fit it, whoſe modeſty was ſuch that he would not derogate the invention of the projection from me, to himſelfe, but ingenuouſly acknowledged it being ſo made up, and contrived, to be the ſame proiection with my Ring*, But the manifeſtation of it, ſo firſt to the world, properly and ſoly belongeth unto him; which *Circles* ſo projected on a *Plate* with an *Index*, was not alſo known untome,as by good teſtimony I can produce,before any of theſ things came to the worlds wiew,though publikely I writ not firſt upon them : the *Learned* in thoſe *Artes*, and thoſe that underſtand th projection, know it to bee one and the ſame, and are not deluded b ſuppoſing a new thing, as many are, for it is but(as a learned ma ſaid)as to turne a *Garment* in and out;A motion muſt performe th operation to give proportionalls with ſuch expedition,and not otherwiſe, as in my *Epiſtle* to the *Reader* upon the uſe of my *Ring* I hav delivered,howſoever the projection on the Plate or Plaine I had publiſhed ere now, not in ſo an unprofitable and obſcure method as i now delivered, had I not beene prevented by ſome others, whoſ callings might have invited them to ſpend their houres better, tha to ſnatch with greedineſſe that out of anothers hands which wa not their owne : for theſe *Circles* of my *Ring* projected on a *Plate* o *Plaine,* ſo fitted with an *Index* at the *Center* as aforeſaid,by cleare teſtimoney in its particulars I ſhall prove in his due place to be anothers, and not the ſuppoſed *Authors*, whoſe conſcience may checke him and tell him herein, that he never ſaw it, as he now callengeth it to be his invention,untill it was ſo fitted to his hand, and that he made all his practiſe on it after the publiſhing of my *Booke* upon my *Ring*, and not before ; ſo it was eaſie for him, or ſome other to write ſome uſes of it in *Latin* after *Chriſtmas*,1630.& not the *Sommer* before, as is falſely alledged by ſome one who hath made himſelfe a ſpokeſman to another in ſome things by *equivocations*,& in other things by confeſſed *untruths*, whoſe ambition to be ſome body, hath incited him forward to deliver ſome ſuppoſed new *ſtuffe*, or *ſcrambling peeces*, if not confuſed *fragments* of his owne, or ſome others, to a publike view, in *obſcure* and *various phraſes*,a thing ſuppoſed to bee forged by ſundry *heads*,rather than by one alone, ſeeing there is ſuch roving from the *Text*; amongſt whom to blow ſome ſmoake thereto, there was ſome groſſe one, ſeeing the matter is ſo common;for to a finer element perhaps his *capacitie* could not aſſent, or aſcend. A blinde *Guide* and a *Parrats* ſpeech are not much different, the one walkes hee knowes not whether, and the other ſpeakes hee knowes not what ; and ſuch are all precepts in *Artes*, which leade and make men ſpeake without *Demonſtration* ; which doth not onely protract the *ſtudious*,and fruſtrate the affectionate,but makes an ingenious ſpirit (who ever is more *Rationall* then *practicall)*

call) to contemne ſuch *Circumlocutions*, and laugh in private, if not in publike, at the learned *ſtile* of ſome *Authors*, who making themſelves by their obſcure kind of writing ſeemingly *famous*, ſticke not to calumniate others to make them *infamous*. Thoſe that are but initiated unto knowledge, for their faylings and defects of order, are worthy of ſome blame, but for others who would ſo-are above all, and not onely picke holes in the coates of the *living*, but alſo vilifie the *dead*, tis a ſhame; making too great haſt at the beginning to glory in that, which no doubt will prove ſhame in the ending. Its a common thing, that, one man having *laboured, planted* and *ſowed*, with great paines, another reaps his *Harveſt* with no induſtry; yet in this there was ſome honeſty ſhewen, not to take the *Crop* but the *Gleanings*, houlding it eaſier to follow a beaten path then hazard a diſcovery, *but the way was not made plaine, and the vaile remooved to helpe his ſight*: *God* that gave me the former *invention* without the adviſe of any, hath alſo reſerved for me the manifeſtation of the latter, without the helpe of any, which I formerly mentioned in the *Concluſion* of the uſe of my *Ring*, to declare as is aforeſaid, and I hope no *envious*, and *inſinuating detractors*, will hereafter aſſume this alſo to himſelfe as his owne, and ſay I had it from him: I have hitherto borne the injury of the infamy with great greefe of heart, (and *God* that is the diſcerner of the *ſpirits* knowes mine integritie and innocencie herein.) The *window* hath beene as yet cloſe, and darkeneſſe poſſeſſeth the place, I will now withdraw the *Curtaine* that the *Sunſhining* light may appeare, to expell thoſe [redacted] miſts that have beene ſcattered, and by a true and ſincere *medium* remove that which was ſuggeſted from a *falſe*. Many have ſpurred me hereto, who ſuffer alſo with me, who wonder at my ſlackneſſe, and long patience, others contrarily have as much gloried, I hope in the end that truth will burſt forth, that *God* may have the glory, man the ſhame: and I doubt not but ſuch as men ſow unto others, ſuch ſhall they reape unto themſelves againe, and with what meaſure they meate, the ſame ſhall be meated unto them, I will therefore in the firſt place anſwer for my *Quadrant*, then afterwards for my *Ring*, and laſtly for my *ſelfe*, and *others*.

The Anſwer upon my Quadrant.

I Have not onely ſuffered by way of divulging of the ſaid projectin of *Logarythmes Circular*, 1630. but alſo by the late publiſhing of my

Horizontall Quadrant, 1631. by a ſcandalous aſpertion couched under the relation of the *Author*, in the words of his *Tranſlator* (but rather his *Tranſcriber*, if not in the moſt of that *Booke* as is ſuſpected, his *Compactor*) which are as followeth, *Which whilſt I went about to doe, another to whom the Author in a loving confidence diſcovered his intent, went about to preoccupate, and prevent, if not Circumvent.* Now becauſe his words are *cautelous* and *ſubterfugious*, we muſt a little examine them; If they be true, then that which I have produced and delivered as mine owne cannot ſtand, well then, this *preoccupating, preventing*, and *circumventing*, and *diſcovering in loving confidence his intention to me*, muſt be eyther about that of my *Horizontall Quadrant* in the making and uſe thereof, or touching that of my *Ring*; the former of which I lately produced before the ſuppoſed *Author* did write ſo publikely upon the ſame *Projection*, as he hath now done in his *booke* named *the Circles of projection*, which tract is ſo farre from being anſwerable throughout, to that which it promiſeth in the beginning, that it ſeemes rather to puſsle the *ſtudeous* then in any wiſe to further them) of which I ſay no more, but adviſe the *ſtudeous Reader* onely ſo farre to truſt as is agreeable to the *Text*, and a true *Doctrinall Method*, which being therein omitted, it doth not onely *ſurcharge the memory of the learner*, but doth much more fruſtrate and delude the *Ingenious*, by a *labyrinth* of tedious *Rules*, and ambiguous precepts, when few might ſerve *demonſtratively*, making them ſpeake *Parret* like, which would be as little *vendible* as it is *abſtruſe*, were it not thruſt on *men*; I would be loath to put an untruth upon it or him, or any other; it were unmannerly, howſoever I will prove that concerning neyther of theſe *Inſtruments*, to wit, that of my *Quadrant*, or that of my *Ring*, the ſaid *Author* did diſcover *his intent unto me*, either in whole, or in part, *in a loving confidence* or otherwiſe. And for the making of my *Quadrant*, I could not *circumvent* him whom I knew not, for I drew the *Proiection* long before ever I heard of the *Authors* name, (as in its due place I can prove) but this aſpertion no doubt was from an inveterate hate of ſome, who endeavoureth not onely to annihilate my intereſt in the *Invention* of that R*ing*, and *Quadrant*, but alſo to bring me in a diſrepute, and to leave a blot of infamy upon my *Name* unto *poſteritie*; But I doubt not in a publike Audience I ſhall cleare my ſelfe of it, and the diſgrace that was intended to be caſt upon me in the *beginning*, may light upon the contrivers thereof in the *ending*, and as there was a pit digged for another, perhaps the diggers may fall therein *themſelves*, let them laugh on, as they have begun while I haſten the *Iſſue of it*. The extendure of *Gods* hand in his donations is manifould, and where his ſpirit pleaſeth to breath, there a dore is opened; now whether the gift to the *creatures* bee *divine* or *humane*, we ſhould bleſſe *God* as the firſt and principall *Author*, and giver of all, no wiſe deſpiſe *man*, as the *ſecond agent*, or receiver: Its very phantaſticall in ſome therefore, who thinke ſuch and ſuch things are not worthy the generall vote and allowance, if they proceede not from ſuch, and ſuch an one, envying they ſhould be produced by any other; which if they be ſo divulged, as much as lyes in them, they will haſten to poſſeſſe the world with a contrary opinion, thereby wronging *God* in his *diſpenſation*, and man in his *reputation*, but ſuch men wedded to a private and deluding fancie, chuſe rather to abandon the *Love* of ſound reaſon, then to be divorced from their *prejudicate affections*. I will in the firſt place therefore make way for my *Quadrant*, that I did not *circumuent* the ſaid *Author* for the attayning thereof, (as before:) But whereas hee taxed me with going about to *preoccupate*, or *prevent him*, it ſeemes ſomewhat ſoaring like, to abridge any mans *free affections*, in conſtraining them to waite on any others concealed intentions, which they never knew (in which every man hath a freedome to himſelfe) It is (no doubt) ſomewhat too malepart, & too rigid, to ty the liberties of others in their actions, who deſiring the good of others in not concealing things, if they ſhall by their induſtrious labours, ſhew the excellent uſe of ſuch or ſuch a thing, to a publicke view, for a generall benefit, are for it *envied* and *calumniated*: which as it ſmells of too great a detracting from others; ſo it hath its ſource from the *philautie*, and *too high conceat* which ſome entertaine of their owne worthines: the ſaid *Author* having had the Projection 30, yeares before by him (as he giveth out) wherefore did hee not publiſh it then, or give way to it as hee hath now done, how could it bee ſo long concealed, and others never ſo much as heare of ſuch a thing, was it that hee would not have the ſame *communicated to others*, or that hee would not *be knowne in his name* by a profitable action, or that ſome others might challenge an *Intereſt* in it beſides himſelfe, or that the uſes of the Projection lay hidden, and obſcure; or that they were not at that time ſo plentifully made manifeſt, untill Mr. *Gunters* ingenuitie opened the myſtery of it, and applyed that projection ſo *methodically*, and copiouſly, to *Horolographie* in his *Booke* of *Dyalling* in the uſe of the *Sector*, and accommodated that Projection long before in a *Dyall* for an *honorable* perſonage, as the firſt that ever was made in that kind, and the ſame forme with theſe that are now made, and therefore to give every man his due, and not to *iniure the dead*, it is properly ~~then~~ Mr. *Gunters Dyall*, for that compoſure, and not anothers, (notwithſtanding the inverting of things and detractions from him) But it ſhould ſeeme he would publiſh it then, eyther when the way was made faire for him, or when he might catch at ſome one, as lately hee hath done in an unfit and uncharitable way: And as Mr. *Gunter* was copious in applying that projection to that particular of *Dyalling*, ſo might he no doubt have beene in the *Aſtronomicall* uſes of it alſo, though he delivered ſo few as but ſix obſervations onely to a publicke view upon that Projection, which before the publiſhing and alſo after, both in the uſes and the Projection it ſelfe I often intentively looked upon, and extracted from them many uſefull performances more, even in Mr. *Gunters* time; and ſince his death have publiſhed my *Horizontall Quadrant*, extracted from that *dyagramme*: in which I have abundantly ſupplyed the emptineſſe and obſcurity of that Projection, fitting it for a *Pocket Inſtrument*, or according to any *magnitude*, as a helpe and benefit to thoſe that are ſtudious of *Mathematicall practices*; which labours, of Mr. *Gunters*, and my owne, if they were not to *unvaile the ſubiect and to make way for another to helpe his ſight*, which writes afterwards, I referre it to an eye not partiall, to be *Iudge*, it being rare and wonderfull for one man to ſee all at once, and there are farre more excellent uſes yet upon that Projection, which may be alſo knowne if ſome one will open the vaile a little more; if there be any that knowes further uſes upon it, let them diſcover them, for the preſent uſe for others, and let them not, if others, more reſpective of the common benefit of ſuch who delight in thoſe things, publiſh them, by ſcandalous detraction deliver that they are *prevented, if not circumvented*. Which *Quadrant* in the originall as before ſpecified I did extract and compoſe from the *fundamentall dyagramme of* Mr. *Gunters Booke of the ſector*, page 66. as I have ſpecified in the *Epiſtle to the Reader*, in the booke of the uſe of *Quadrant*, howſoever the ſuppoſed *Author* (having the free liberty granted to ſee my *Epiſtle* before it was printed, and alter whatever he thought fitting, (I being unwilling to oppoſe his deſires) did daſh out whatſoever I had there to my knowledge juſtly attributed to Mr. *Gunter*, becauſe he ſaid it did belong to him primarily, yet I muſt ſay that I was eſpecially behoulden to the labours of Mr. *Gunter* who is now at quiet in his *Grave*, and therefore not to bee wronged. And ſhould I ſearch the originall from the firſt, neyther Mr. *Gunter* nor eſpecially hee may challenge ſo much unto himſelfe, ſince the maine draught out of which theirs is extracted, was extant before they were borne, namely in that auntient *Geographer Munſter* in his *Dyalling*, where it ſtands obuious, as alſo in the famous [redacted] *Orontius*, as I mentioned in my former *Epiſtle*, but I ſuffered him to put it out, being (it ſhould ſeeme) unwilling to have his owne diſmantled; As alſo at that time, I ſhewed him in our *Engliſh Blagrave* the like Scheme, in both their workes, long ere hee or Mr. *Gunter* committed any ſuch thing to a publike view; howſoever, I had not the leaſt touch of furtherance from him, or from any man breathing, either by tranſcripts, or verball direction, (but onely what I have formerly acknowledged out of Mr. *Gunters* Booke of the *Sector*, page 64.65.66. though in other triviall matters I doe and ſhall acknowledge freely) as hath bin falſely alledged by ſome looſe tongued *Inſtrument*, that I had the making of that *Quadrant* by a ſight of the *Authors letter*, whoſe honeſt relation may bee ſuſpected, ſeeing hee makes ſo little conſcience, to detract from anothers reputation whoſe detraction is grounded upon as great a ſtabilitie, as uncertainty, whoſe *Baſis* is onely a bare ſuppoſition, conjoyned with an indiſpoſed evill eye, as full of envie, as emptineſſe of charitie, and this upon examination he is able to make good, and no more, which a generous or tender breaſt ſcornes to harbour, much leſſe ſo partially to divulge: But it will no doubt make ſuch *Tale tellers* ſo much the more odious to the ſweet diſpoſition of ſuch *noble ſpirits*, when they ſhall be poſſeſſed with the manifeſtation of the contrary, which will no doubt ſhake the foundation of that Projection, by letting the world know it from the originall, that he which hath given way and gloried at the countenancing of that aſpertion, and as the ſuppoſed *Author of that Projection*. perhaps may be challenged by others, as I mentioned before, howſoever therein very ingenious, by ſo aſſuming the *Projection* to himſelfe (as in his owne words) but not ingenuouſly enough acknowledging from whence he had it: for my particular, I take God to witneſſe I have without any *equivocation* or mentall reſervation, declared in every particular the very naked truth. in the *Epiſtle to the Reader* in that Booke of the aforeſaid *Quadrant*, from whence I had that *Quadrant*, and how I produced it, and it might have bin eaſily ſo compoſed, and publiſhed, as I have done it, by another, (without the helpe of the ſight of a *Letter*,) that is but indifferently verſed in delineations, ſeeing the Projection in my *Author* Mr. *Gunters Booke*, page 65.66. as aforeſaid lies ſo plaine & conſpicuous (notwithſtanding) in which letter to my remembrance I ſaw but ſome ordinary uſes, and a checke caſt upon Mr. *Gunter*, but no directions in it for the making of the *Inſtrument*; which uſes I ſlighted as meane, and triviall, and other things I ſaw not: and this I ſpeake not to ſhuffle things off, but out of a true ſincerity, but perhaps ſince the ſight thereof there may bee inſerted ſomewhat elſe, to make my oppoſites aſſertion good, howſoever I needed not ſuch a helpe by the ſight of a *Letter*, ſeeing *Ioyners*, *Carpenters*, and other *Mechanicks* about this *Towne* & elſe where, yea, *Schoole Boyes* in imitating the Projection aforeſaid in Mr. *Gunters Booke* of the *Sector*, and following the directions therein in the 66. page of the uſe of the *Sector* aforeſaid, have drawne the Projection fully and compleate by the Booke alone; and others having onely had but a ſimple view of my *Quadrant*, many yeares before I publiſhed the uſe thereof, have from the aforeſaid *Booke* of the *Sector* page 66. made the like, having not had the leaſt aſſiſtance from any, but the direction of the Booke onely, as upon oath they have beene examined, and doe acknowledge, and will teſtifie it when occaſion requires: beſide I know ſundry *Gent.* and others in this *kingdome*, that are yet living, that have drawne the ſame Projection by the Booke, alone immediatly after the publiſhing of it 1624. as at this inſtant they wil be ready to confirme, and my ſelfe in Mr. *Gunters* time 1622. (beſides many others) have drawne the ſame Projection, for our particular uſes, and are yet to be ſhewen, wch was long before either I, or they ever heard of a new *Author*, of that Projection beſides Mr. *Gunter* onely: And to make my aſſertion yet more abſolute, I did not onely draw the Projection in Mr. *Gunters* time, but before his death did alſo ſhew the making of it to others; therefore (as before) I could not circumvent the ſaid ſuppoſed Author, to have any aſſiſtance from him in making of my *Quadrant*, either by a verball declaration, or by the ſight of a letter: or otherwiſe, which in its due place God permitting life, and health, ſhall be confirmed more at large in every title.

Upon my Ring.

IF I circumvented not the ſaid *Author*, nor that in a loving manner he opened his intent unto me by aſſiſting of me in the making of my *Horizontall Quadrant*; Then to make his aſſertion good, it muſt neceſſarily be in the other *Inſtrument*, which I produced and publiſhed, to wit, that of my *Mathematicall Ring* (that is, how I might compoſe or make the ſame) but concerning this latter Projection of the *Ring* or any thing to that effect, *in a loving manner then, or at any time, or otherwiſe that he diſcovered his intent unto me,* it can hardly bee collected (certaine circumſtances ſeriouſly weighed, and conſidered) The whole ground of which being from as weake a principle, *to open the way unto me for the making of my Ring*, as the ſight of a *Letter* to ſhew me the making of my *Quadrant*; for about *Alhalontide* 1630. (as our *Authors* reporteth) was the time he was *circumvented*, and then *his intent in a loving manner (as before) he opened unto me*, which particularly I will diſmantle in the very naked truth: for, wee being walking together ſome few weekes before *Chriſtmas*, upon *Fiſhſtreet hill*, we diſcourſed upon ſundry things *Mathematicall*, both *Theoricall* and *Practicall*, and of the excellent inventions and helpes that in theſe dayes were produced, amongſt which I was not a little taken with that of the *Logarythmes*, commending greatly the ingenuitie of Mr. *Gunter* in the *Projection*, and inventing of his *Ruler*, in the lines of proportion, extracted from theſe *Logarythmes* for ordinary *Practicall uſes*; He replyed unto me (in theſe very words) What will you ſay to an *Invention* that I have, which in a leſſe extent of the *Compaſſes* ſhall worke truer then that of Mr. *Gunters Ruler*, I asked him then of what forme it was, he anſwered with ſome pauſe (which no doubt argued his ſuſpition of mee that I might conceive it) that it was *Archingwiſe*, but now hee ſayes that hee told mee then, it was *Circular* (but were I put to my oath to avoid the guilt of Conſcience, I would conclude in the former.) At which immediatly I anſwered, I had the like my ſelfe, and ſo we diſcourſed not a word more touching that ſubject: all which ſundry times ingenuouſly according to the very truth the ſaid ſuppoſed *Author* hath acknowledged before divers perſons, who doe and will teſtifie the ſame: Then after my comming home I ſent him a ſight of my *Proiection* drawne in *Paſtboard*: Now admit I had not the *Invention* of my *Ring* before I diſcourſed with the ſuppoſed *Author* thereof, it was not ſo facil for mee or any other *(to an eye not partiall)* to raiſe and compoſe ſo complete, and abſolute an *Inſtrument* from ſo ſmall a principle, or glimpſe of light, but was knowne unto me, (as I have produced it) long before that time, and being now publiſhed as it is, the compoſure of it ſeemes moſt facil, (as all inventions doe, once knowne) that I have much wondred with my ſelfe, that Mr. *Gunter* or ſome other produced it not ſo to the world as now it is, ſeeing it was ſo eaſie, and caries with it ſuch an excellency, above that which is in the *Lineary forme*, for in a

Circle it is naturall, & perfect, in a line defective & imperfect: But he, or they, perhaps ſaw it not, though their ſight I confeſſe (no wiſe to diſparage their worth) might penitrate further in other things: but gifts may not be attributed to naturall ingenuitie, but to God the giver of them, who diſpoſeth where his goodneſſe pleaſeth. And who knowes to the contrary but many private men in this *kingdome*, or elſewhere, might have this *Invention* long before my ſelfe, or he that now challengeth it, ſeeing the gifts of God in his donations, to ſeverall perſons, are oftentimes in one and the ſame thing, and if God beſtowes his *Talents* on us, we ought to communicate them to others, which not to doe, is to hide them in a Napkin, and who ſo concealeth them are not free from ſome reprehenſion: our *Author* may anſwer for himſelfe, who reporteth now that hee had the Invention for more then twelve *yeares* paſt, but put it not to uſe, which in a ſenſe was injurious both to *God* and *man*, if hee ſaw the copious, and compendious uſe of it then, as now hee doth; to mee and to many others it hath ſeemed ſtrange, that he ſhould hide ſuch an excellencie, ſo long in obſcuritie; But it is ſuppoſed, that hee had then but a glimpſe of its performance (untill I writ upon it, by opening the *Cabenet*, and ſhewing its treaſure to the world) and ſo regarded it not then as a Iewell, but ſince. But when I had a ſight of it, which was in *February 1629.* (as I ſpecified in my Epiſtle) I could not conceale it longer, envying my ſelfe, that others did not taſt of that which I found to carry with it ſo delightfull & pleaſant a taſte, knowing that as the *Logarythmes* (as a *Iewell*) that did excell all Inventions that ever went before it, ſo this kind of Projection, as the daughter ſpringing from ſo noble a *Mother*, was the rareſt *Inſtrumentall Gemme*, that ever Art in all preceeding *Ages* did afford: which in its production heretofore lay obſcure, but now being publiſhed how cleare doth it ſeeme to bee in its compoſure, and if it were ſo eaſie at the firſt to produce (as ſome account it) why did not ſome one all this while ſince the publiſhing of it (being now more then two *yeares* paſt) inlarge that Invention, or deliver others in that nature of their owne, being eaſier to adde unto an Invention, now being divulged, then to deliver its originall? But hitherto it hath ſeemed difficult, many having attempted and endeavoured, but have fayled in their ends, howſoever I know not what ſome private mens induſtry hath produced by way of augmentation to that invention of my *Ring*, or the *Logarythmes Projected Circular*: At the *Concluſion of my Booke* I gave a ſufficient and perſpicuous direction, and invitation thereto, that ſo by the former labours, and the other there intended, the way might be made faire, and the Ice broken that they might wade the eaſier : and ſo produce at laſt ſomething for a publike uſe by Augmentation to this Invention, at which I ſhall much rejoyce, rather then any wiſe envie : But I have as yet all this while demurred in my pretended purpoſe, and being often times by ſundry men importuned, according as I have promiſed, to inlarge that Invention, ſeeing none as yet hath done any thing therein, I have now at laſt therefore for their benefit, & others, to a publike view delivered what is mine owne to that end : and that by ſundry wayes, and how eaſy doth the inlargement of that *Invention* now alſo ſeeme to be, being now produced. With the like facility did I compoſe long agoe my *Helicall line of Roots* which affords five places accuratly, by an inſpection of the eye onely, which being not as yet divulged to a common view may to ſome ſeeme difficult for its compoſure : The ſecrets and intentions of the mind, how cloſely are they lodged in the breaſt, and who can ſearch the heart, that from a word barely delivered the whole may be conceived; therefore, it was not eaſy for me to know the *Authors* intent in his project by a bare word, had not God long before opened the way unto me, how this projection, or Invention might be compoſed; what meanes then theſe words ; that *in a loving confidence the Author diſcovered his intent unto me?* is it not to give a faire floriſh upon a untrue *ſubject*, to delude, if not to poſſeſſe *Men* with a falſitie, to detract from another his good name; beſides the barrenneſſe of the word we will a little conſider the ſtraightneſſe of time, in the original, for the producing of the *Booke*, and *Invention*, as is challenged by the *Author* to be about *Alholantide*, 1630. & that then *his loving intent to me be opened, and ſo was circumvented*; I will put my cauſe into the hands of any indifferent *Iudge* to cenſure of it, that having had no other direction, or light from the ſaid *Author* then formerly is ſpecified, (for more hee dares not avouch with a cleare conſcience) how could I from it ſo eaſily forme my *Projection:* Mr. *Gunters Ruler*, as ſome thinke, was a furtherence to me, but it was rather a hinderance, for his *line of Numbers* was as impertinent for me to follow, as ſuch a double compoſure in the projection was ſuperfluous, therefore ſuch a bare verball (as before) or *Inſtrumentall* dictate was not uſed, or could be ſufficient to compoſe ſo high a worke : but it was from a long intentive precogitation of many *yeares* with my ſelfe, how the *Logarythmes* in the *Tables* might be ſo compacted, that all *Numbers* in theſe *Tables* ſhould bee proportionall one unto another, and according to a divers, and variable proportion aſſigned ; which to effect I found at the firſt very difficult, and could not conceive how otherwiſe it might bee done, but either by fitting of *Tables* to all proportions, which ſo to doe would not onely be too great for *operation*, but alſo breede confuſion; or it muſt be from ſome graduated inſertion of theſe *numbers Inſtrumentally*, ſo that by motion numbers might be mooved one unto another; and for expedition of which I found no figure more apt then a *Circle*, and on that my *Meditations fixed*, and there I reſted, and ſo (as my few houres could permit me) I made ſeverall projections, that the ſenſes might ſee the effect of it in a perfect beauty, which the intellect ſaw before but in obſcurity: about which how often was I afterwards interrupted in my deſires to looke further into the *myſteries* that lay open in that new *Invention*, having not ſcarce an houre in a day, and ſometimes not two houres in a weeke of ſerious *privacie* (by reaſon of my calling) to ſport my ſelfe in operation thereon (for it ſeemed ſo to me then as a recreation, as all new *Inventions* at the firſt doe to any that invents them) It was many *monethes* therefore before I made tryall of it, in the generall uſes that it might bee put unto, in matters of *Arithmeticke*, for common operations, and to the meaſuring of *Plaines* and *Solids*, but eſpecially how it might be applyed to the doctrine of Plaines and *Sphericall Triangles*, in *Aſtronomicall Calculations*, *Nauticall practices*, and *Horologicall* concluſions, all which in every particular I practiſed on it at ſuch times as convenience would permit mee; And having for many *monethes* thus ſatiated my ſelfe, and fed my fancie upon its *Theoricall contemplation*, and its *Practicall operation*, though oftentimes I found many Rubs and impediments in the *Practiſe*, in applying this inſtrumentall Invention at the firſt ſo generally and copiouſly as I did; And it cannot bee denyed of any, that the wayes of new Inventions lies not ſo obvious, or ſo eaſie, to bee diſcovered with ſuch celerity, as a long premeditation might produce; I was deſirous therefore to make the world participate thereof alſo; Therefore at ſeverall times, having but a little time at any time, by little and little did I compoſe and produce a method pleaſing to mine owne fancie; doing one weeke ſuch a peece, another weeke another, and ſo going on untill I had runne through the whole parts of *Arithmeticke*, in the *Goulden Rule* direct, and indirect, in *diviſion* and in *multiplication*, applying all theſe to manifold uſes in *combination of Numbers*, to *common affayres*, in *fortification*, to *menſuration*, and *fractionall operation*, then I applyed the *Inſtrument* to the finding of numbers in *continuall proportion*, in finding of meane *Proportionalls*, and the extracting of *Rootes*, I laboured further to make the *Inſtrument* more complete that it might worke all uſefull proportions touching *Intereſt*, or valuation of *Leaſes*: and laſt of all I applyed the *Inſtrument* in the *Circles* of *Sines*, and *Tangents*, to ſome uſes of *Aſtronomy*, in the finding of the *Declination of the Sunne*, and its *aſcention* through all *Latitudes*; Theſe things I drew up in a Booke at ſeverall times aforeſaid, as a part of the practiſes that I made upon it: And it was a task ſufficient for a man that had cōmand of his *houres*, by allotting them ſoly to that end, in as long a time as was betweene *Alhalantide* & *Chriſtmas*: in the opening of the way of that new *Invention*, & by applying of it ſo, (to uſe for a publike view) rather then by one that was commanded by them, eſpecially at that time and all the *Tearmes* before: for how few are the *houres* that a man of any imployment gets to ſet upon a new *method* for a new *Invention* at ſuch a time, I leave to any indifferent eye to judge; and it would have beene ſo much the more harſher, and difficult to have it ſo ſuddainly produced, had it beene then at *Alhalantide* but onely conceated, and agitated on, but it was premeditated on long before, as is aforeſaid, and intended for a *new yeares gift* for the *King*, which accordingly I gave him on *new yeares day*, though a fortnight, or three weekes before *Chriſtmas*, his Ma^{tie} received from mee a Scheme of the *Projection* in *Paſtboard*, with a manuſcript of the *Booke* which is now publiſhed, agreeable to it in every tittle, (the *Epiſtle* excepted) a *Copy* of which was then at the *Preſſe*: and was *Printed* foure dayes before *new yeares day*, 1630. *Now* that all theſe *Practices*, and many Tranſcripts that were drawne, with the doubts and hinderances that did ariſe in the fitting of theſe things, could bee made, ſo ordered, and produced in ſo little a time, as the ſcattering of a few *houres* as betweene *Alhalantide* and a moneth before *Chriſtmas*, I leave to the *Iudicious Reader* to cenſure: I broke the *Ice*, and made the way facil for another that came behinde mee; yet if hee tooke a *yeare* and more to meditate and write upon my endeavours after my publication (thereby not to ſignifie that hee wanted time, but takes liberty enough if not too much, to the loſſe of time) as long a time, halfe of it, or a quarter of that time, may by a *Charitable boone* be granted mee. Which conſideration of time, will eaſily alſo cleare mee from the imputation of the *Authors loſe aſſertion*, that hee was Circumvented by mee, nor that in a loving confidence he opened his intent unto me. Yet in the laſt place I will haſten to vindicate his untrue declaration before the *Courts of juſtice*; if reſtitution be not ſpeedily made, where true *witneſſes* ſhall bee produced, and that which is now but in agitation I will bring to action, and prove that before *Alholantide* or very neare that time, my *Invention* was produced to a publike view; therefore it was very injurious in the *Author* to poſſeſſe the world with ſo an untrue *aſpertion*, upon a bare *ſuppoſition*, in that I ſhould have the *Invention* frõ him, and that in a louing manner he opened his intent unto mee, and was *Circumvented*, as before, whoſe aſſuming diſpoſition hath not onely bin buſie to take from me my good name, & labours by this his looſe *aſpertion*, but hath alſo endevoured (by too rigid and generall a cenſure ſparing none in ſome ſence) to bring all in a common diſrepute in their *Callings*, therefore,

In the behalfe of vulgar Teachers & others.

BY way of advertiſement to you, and my ſelfe, & to whom it may concerne, *vulgar Teachers* of *Mathematicks* about this *Towne* and *kingdome*, as you are ſtyled, which had bin faire (if no worſe) ſeeing you are not profeſſors, or publike *Readers*, but common Teachers, it behooves you, and me, that we indeavour to avoyd the diſreputation of a ſcandalous attribute in our profeſſion of ſo noble a *ſcience*, that our doctrines be not onely *Practicall*, but alſo *Rationall*, and *Theoricall*, that we may not bee ranked with *Iuglers*, and teachers of *Tricks*, as we are lately glanced upon publikely, but a charitable breaſt howſoever (I perſwade my ſelfe) hath a better opinion of us, that according to the *Talent* that God hath given unto us, out of the *Riches* of his *bountie*, no doubt in our callings we uſe them rightly, and doe not (by deceiving) derogate from the end, which is, to *glorifie God* in theſe *gifts* in a true and ſincere uſe of them; which otherwiſe would not onely be a blemiſh and ſtaine to our *name* but alſo a diſhonour to our *noble profeſſion*, the large teſtimony of which (no doubt) every one of you in his particular can produce, (notwithſtanding ſuch an uncharitable cenſure) can amply teſtifie in your callings your *ſufficiency*, and therein remoove all ſcruples to confirme your *integritie*; and as the *imputation* hath lighted heavy upon us, ſo hath it not reſted there, but rebounded likewiſe *(if the words be truly ſcanned)* unto ſuch *Nobility*, and *Gentrie*, to which we have beene ſervants to or in preſent are, in ſo honourable and laudable a *ſervice*, which aſpertions are as highly backed with arguments, as he was to ſorwords that divulged them: whoſe judicious and cenſorious eyes, hath beene two much buſied to ſhew the wayes of the *Iugling* of others, and prove delinquents in the ſame things themſelves, whoſe words are theſe, *That it is a prepoſterous courſe of vulgar Teachers, to begin to teach with Inſtrument, which was not oncly to deſpight Art, to betray willing and induſtrious wits to ignorance, and idleneſſe, but was alſo loſſe of precious time, making their ſchollers doers of tricks, as it were Iuglers.* Which words are neither *cautelous*, nor *ſubterfugious*, but are as downe right in their *plainneſſe*, as they are touching, and *pernitious*, by two much derogating from many, and glancing upon many *noble perſonages*, with too *groſſe*, if not too *baſe* an attribute, in tearming them *doers of tricks, as it were to Iuggle*: becauſe they perhaps make uſe of a *neceſſitie* in the furniſhing of themſelves with ſuch knowledge by *Practicall Inſtrumentall operation*, when their more weighty *negotiations* will not permit them for *Theoricall figurative demonſtration*; thoſe that are guilty of the aſpertion, and are touched therewith may anſwer for themſelves, and ſtudie to be more *Theoricall*, then *Practicall*: for the *Theory*, is as the *Mother* that produceth the *daughter*, the very ſinewes and life of *Practiſe*, the excellencie and higheſt degree of true *Mathematicall knowledge*: but for thoſe that would make but a ſtep as it were into that kind of *Learning*, whoſe onely deſire is expedition, & facilitie, both which by the generall conſent of all are beſt effected with *Inſtrument*, rather then with tedious regular *demonſtrations*, it was ill to checke them ſo groſly, not onely in what they have *Practiſed*, but abridging them alſo of their liberties with what they may *Practiſe*, wch aſpertion may not eaſily be ſlighted off by any *gloſſe* or *Apologie*, without an Ingenuous *confeſſion*, or ſome mentall reſervation: To which vilification, howſoever, in the behalfe of my ſelfe, & others, I anſwer; That *Inſtrumentall* operation is not only the Compendiating, and facilitating of *Art*, but even the glory of it, whole demonſtration both of the making, and operation is ſoly in the *ſcience*, and to an *Artiſt* or diſputant proper to be knowne, and ſo to all, who would truly know the cauſe of the *Mathematicall operations* in their originall; But, for none to know the uſe of a *Mathematicall Inſtrumen*, except he knowes the cauſe of its operation, is ſomewhat too ſtrict, which would keepe many from affecting the *Art*, which of themſelves are ready enough every where, to conceive more harſhly of the difficultie, and impoſſibilitie of attayning any skill therein, then it deſerves, becauſe they ſee nothing but obſcure propoſitions, and perplex and intricate demonſtrations before their eyes, whoſe unſavoury tartnes,to an unexperienced palate like bitter pills is ſweetned over, and made pleaſant with an *Inſtrumentall compendious facilitie*, and made to goe downe the more readily, and yet to retaine the ſame vertue, and working; And me thinkes in this queaſy age, all *helpes* may bee uſed to procure a *ſtomacke*, all *bates* and invitations to the declining ſtudie of ſo noble a *Science*, rather then by rigid Method and generall *Lawes* to ſcarre men away. All are not of like diſpoſition, neither all (as was ſayd before) propoſe the ſame end, ſome reſolve to *wade*, others to put a *finger* in onely, or wet a *hand*: now thus to tye them to an obſcure and *Theoricall* forme of teaching, is to crop their hope, even in the very bud, and tends to the fruſtrating of the profitable uſes, which they now know, and put to ſervice, and to the hindering of them in their further ſearch,in the *Theoricall* part, which otherwiſe they would apply themſelves unto: being catched now by the ſweet of this *Inſtrumentall bate*; which debarring would not onely injure the *ſtudeous* but alſo cauſe the *Mechanicke workemen* of theſe *Inſtruments*, to goe with thinner *clothes*,and leaner *cheekes*.

Neither doth the uſe of *Inſtrument* to a man ignorant of the cauſe of its operation,any wayes *oppoſe or diſpite Art*, ſeeing that the end of producing and inventing of *Inſtruments*,is their *Practicall uſe*; Beſides,its impoſſible to ſhew the uſe of an *Inſtrument* but in teaching there muſt needes be laid downe ſome grounds or prolegomenas, as, what is meant by ſuch,or ſuch names;what are ſuch, and ſuch tearmes, and therefore the beginning of a *mans knowledge* even in the uſe of an *Inſtrument*,is firſt founded on *doctrinal preceps*, and theſe precepts may be conceived all along in its uſe:and are ſo farre from being excluded, that they doe neceſſarily *concomitate* & are contained therein:the *practicke* being better underſtood by the *doctrinall part*, and this later explained by the *Inſtrumentall*,making precepts obvious unto ſenſe, and the *Theory* going along with the *Inſtrument*, better in forming and inlightning the underſtanding,&c. *vis unita fortior*, ſo as if that in *Phyloſophy* bee true,*Nihil eſt intellectu quod non prius fuit in ſenſu*, and things the more they be objected to the ſenſe, are more fully repreſented to the *underſtanding*, then it muſt needes follow that a doctrinall propoſition laid firſt open to the *eye*, and *ſenſe*, and well perceived enters more eaſily the dore being opened, then if the intellect by the ſtrength of its active ſenſe, ſhould eliciate, or ſcrew out the meaning by a long excogitated operation; Its not therefore requiſite unto all *Capacities*,to have *Inſtrument* ſevered from *ſcience*, in many things, is though the uſe of one could be without the other, leſſe or more.

Neither doth the *practiſe* on them *betray willing & induſtrious wits to ignorance and idleneſſe*, that aſſertion therefore is very *ridiculous*, for he that is induſtrious, and willing to ſpend his houres, for the attayning of any ſcience, according to *doctrinall method*, buſieth himſelfe not with *Inſtruments*, but applies himſelfe to ſuch *Authors*, or ſuch compendious abſtracts, as are taken from them, which doe not onely open the eſſentiall parts of the ſubject in the *Theory*, but alſo layes downe ſuch *documents* and *principles* which may (in a higher nature and way) induce him to practiſe them, then poſſibly by *Inſtrumentall* operation for exactneſſe can bee attayned unto; for ſuch is the excellency of *Art* by *Theoricall doctrine*, that all things tending to *practiſe* may bee done by the *ſcience* onely, without the helpe of Inſtrumentall operation, certaine propoſitions being granted, which originally and principally are proper unto *Inſtrumentall* obſervation, being the *Baſis* or foundation of the whole; Therefore *ſcience*, as before, hath a principall dependance on *Inſtrument*, but is it in their *obſervation*, rather then in their *operation*, and the Inventions that are daily produced in that kind, are onely to compendiate and facilitate practicall things, which the learned in thoſe Arts (having the *ſcience*) ſcarce uſe at all, if at any time they uſe them, it is in ſmall and triviall things to ſatisfie the ſenſe, and not the intellectuall part; which *Theoricall* way doth not onely augment the deſires of the *Teachers* in the accommodating things, and remove of difficulties, by making them conſpicuous to the *learner*; But alſo by ſo proceeding cauſeth the *Teacher* to adde many ends both pleaſant and uſefull, by the way, for the *Practicers* incouragement. To begin with *Inſtrument* is unprofitable for the *Teacher*, though advantagious to the *learner*, (if his ends be but to know ſome uſes upon an *Inſtrument*, as it is with many) for it is eaſier for a man to learne more uſefull *Practiſe* upon ſome *Inſtrument* in one houres *Inſtruction*, then to know the cauſe in 20. houres of ſome *Inſtrumentall operation*: and yet there are many *Inſtruments* almoſt as facil in their *demonſtration* as in their operation; Which kind of beginning to teach, or uſuall proceeding therein is not as vulgar *Teachers uſe*, but is as indirect in the *Method as falſe in the aſſertion* (if they may poſſibly avoid it) for that were to teach againſt their owne *profit*, and the *dignitie of learning*; Yet that any *Teachers of Mathematicks* ſhould be ſo nice as to deny the uſe of *Inſtrument*, to ſuch *Gent.* or others, who perhaps deſire the *Theory* to contemplate on hereafter: but the practicke for their private ends, for the preſent, were not onely to fruſtrate their deſires, but injure their occaſions; who might rather laugh at the teachers *pride*, then contemne his *Art*.

Laſtly, that the *practiſe* on a *Mathematicall Inſtrument ſhould be loſſe of precious time*, (to any one that knowes how to uſe them in their *practiſe* though not in the *Theory*) is not onely *ridiculous* but alſo untrue and abſurd, for to what end did the manifold and laborious calculated *Tables of the learned* in their *Subtenſes, Sines, Tangents,* and *Secants ſerve*, were they not to avoyd the great toyle of *Algebreticall* worke in *Radicall extractions*, which otherwiſe in *Trigonometrie* (the *practicall* end of *Theory*) muſt neceſſarily be uſed, but they were Invented & produced to avoid the loſſe of *time*, to the more *learned* (who know the cauſes of their *operation* in the *Geniſes*) and as a facilitie to open the way unto the unlearned, though thouſands working *Trigonometrie* by them knowes not ſcarce the cauſe of ſuch operation, which in a manner is as meere *Mechanicall*, as if it were *Inſtrumentall* (though more accurate in its performance) *But* to come nearer unto theſe preſent times, how hath the Invention of *Logarythmes*, taken away the *labour and loſſe of time*, that was uſed in former *calculation*, for that which cannot be done by the common *Tables of Sines, Tangents* & *Secants* in 20. *hours*, is now done by the helpe of the *Logarythmall Tables* in one *houre*, & there are thouſands in the world that alſo worke by them for their private uſe, by reaſon of their great quickneſſe, in hard and laborious matters, who know not the cauſe alſo why theſe *Numbers* ſhould ſo expedite ſuch a difficultie, with ſo great a facilitie, & celeritie: yet they uſe them though the performance be alſo mechanicall, that they may not likewiſe loſe time: *Now Inſtruments* though they bee extracted from *Tables*, yet according to their *capacitie* in *practiſe* they exceede theſe *Tables*, in all common ſerviceable uſes, that I dare maintain that what the *Logarythmes* by the *Tables*, for giving of *proporticnalls*, either in *Numbers*, *Sines* or *Tangents*, will doe in 20. *houres*, my *Ring* or the *Circles* ſo projected from it, will doe in one houre. Which *Inſtrumentall* Invention, I have alſo produced to helpe the ſtudeous to avoyd *the loſſe of pretious time*, which to omit and keepe them from it (in ſome occaſions) were alſo miſſpending of time: Therefore in reſpect of private mens ends, to begin with *Inſtrument* is not to *Iuggle, nor to doe tricks, neyther to oppoſe or diſpite Art, or to betray willing and induſtrious wits to ignorance and idleneſſe, nor loſſe of pretious time.*

But

BVt I would be loath while I ſeeme to vindicate the loſſe of time, cauſe others to loſe it, by my too prolix defending of it; the vindicating of the truth indeed was my cheefeſt ayme, which I hope will be my ſpokeſeman & defend it ſelfe, meane while not to hould my Reader too long, I wiſh with all my heart that ſuch occaſions were taken away, then might he ſpend ſo much time in reading better things, and I in propagating, not in defending my right; detraction, Calumnie and defamation come cloſe to a man, and therefore my Reader may excuſe me if I be ſo tender of it, ſince it may be his owne caſe (how innocent ſoever) perhaps the very next of all. There is (and I am not the firſt nor it may be the laſt truly ſenſible of it) a generation in the world true ſalamanders whoſe delight is to live in the fire of contention, endeavouring to loade others with Calumnie and detraction, and to raiſe unto themſelves a proud Babell out of others ruins; a vice odious both to God and man, thereby forgetting the rules of equitie which ought to be obſerved, ſo to deale with others as one would be dealt withall, thereby blemiſhing the good name of another, who are not ignorant (or at leaſt ſhould not be) how pretious the name of a man is: is it not above Riches, above pleaſure, aboue Gold it ſelfe? Calumnie indeede is the fire this Gold is caſt into ſometimes, onely heeres the difference, this purifies the one, and that ſtrives to pollute the other; nay, what ſpeake I of thoſe groſſe things, is it not dearer then life it ſelfe, being the very life of the life here, and eternitie of a mans life hereafter? If he that ſteales but a ſmall matter from his neighbour is obnoxious to puniſhment, ſometimes unto death, is not he much more worthy of the ſame, and greater puniſhment that layeth violent hands upon that which is above life it ſelfe? If reports were true, private admonitions may win men, if falſe why are they then divulged? and grant the reports be true, yet, is every report to be ſpoken? may not a man breake the ninth Commandement that divulges theſe reports though true, which tend to the infamy of another? and how much more is he guilty of this breach, that is not onely a blazer of ſuch reports, but a compiler? Is not Satan ſtiled from this word of Calumniation? doth he not Calumniate God to man, and man to God, and one man to another? and ſhall any man tread in his ſteps? is it not the precept of the Pſalmiſt, or rather of God by the Pſalmiſt that every one ſhould ſet a watch before the dore of his lips, and keepe in that unruly member, that is, a world of wickedneſſe? what is the ſtroake of the hand to the ſtroake of the tongue? the one wounds the body, the other wounds the ſoule; the one may be eaſily cured, the other hardly; the one ſtrikes them that are preſent, the other thoſe that are abſent; the one ſtriks but one at a time, the other ſtrikes many at the ſame time, at leaſt three at once, with the ſelfeſame blow; viz, him whom he doth traduce, him who heares him, and himſelfe, and many times the laſt moſt of all; and ought wee not to take great care how we order this unruly tongue? what Gall, what Poyſon, what Wormewood, what Wildbeaſt is to bee compared with the tongue, which lancinates, teares, and wounds the ſoule, by the virulencie of its words, and reports: Looke into the heavie judgement of God againſt ſuch, 1 Cor. 6. that revilers *ſhall not eſcape puniſhment.* Such *was the account of the preciouſneſſe of a mans goodname in* ancient times, *that there hath beene Lawes utterly to baniſh ſuch from the ſociety of men, who by their* Calumny *and* detraction *ſeparate all good ſocietie amongſt* men, *making* foes *of* friends, *and breaking the ſweet bands of* peace *and* charity, *cauſing nothing but* brawles *and* diſſention; *and as neare as they can diſſolving this goodly frame into the ancient Chaos of confuſion. Againe, ſome of the Antients herein are ſo violent that they call it* Grave malum, Turbulentum Dæmona Peſtem peſtiferam, *and profeſſe plainly*, Qui detractioni ſtudent diabolo ſerviunt, *ſo that as* Coales *are to burning* Coales (*ſaith the wiſeman*) *and* wood *to* fire, *ſo is a contentious man to kindle ſtrife The words of a* Tale bearer *are wounds, ſaith he, they deſturbe a mans* Peace *and goe downe into the inwards of the belly, and a whiſperer ſeparateth deare* friends. *I wonder what neede theſe Lamiæ gad ſo much abroad having worke enough at home,* Te prius corrigas quam alterum corrigas, *If ſuch would turne their eyes inward they ſhould finde matter enough to mende in themſelves firſt, and afterwards they might reprehend others,* ſed ad delicta noſtra Talpæ, ad aliena ſerpentes ſumus. *It was once* Conſtantines *ſpeech, That hee would throw his* mantle *over his brothers* nakedneſſe *rather then lay it open; what ſhall wee thinke meanewhile of thoſe who would faine diſcover nakedneſſe, where they can finde none? what ſhould bee the plot, except it bee to feede the boſome* Wolfe *of* envie *and* malice *which at laſt will gnaw out their owne* bowels? *doe they envie becauſe* God *gives to one* man *one gift, to another* man *another? would they have all, and others none? If the* whole body *were an* eye *where were the hearing, if an* eare *where were the ſmelling? ſo, were all contracted into one, what would become of the reſt? No, rather let every one be thankefull unto* God *for that hee hath, then envious for that hee hath not;* God *hath ſtore enough for all, let us not envie one another; if one pull downe the houſe as faſt as another builds, what will become of the* building? *rather let all build and then a goodly ſtructure will be ſooner finiſhed.*

Quod Sapimus conjungat Amor, quod vivimus uno
Conſpiret ſtudio; Nil diſſociabile firmum.

Nature *it ſelfe teacheth us to make much of union, without which all falls to* ruine; *See we how the* dayes *part equall ſtakes with the* nights, *and if one have a greater ſhare now, it allowes the other it afterwards.*

The *Sun* not all doth claime, but *Moone* and *Starres* have ſhares,
And greater *lights* neede not envie the leſſer theirs:
The Land not all doth keepe but gives the *Sea* its *bounds*,
Hills have their *tops*, and let the valleyes have their *rounds*.

The *ſweet combination of* Elements *and* inanimat bodies *may teach us* concord; *Fire and water, earth and ayre howſoever oppoſite in themſelves in both qualities, yet in mixtion and compoſition ſweetly conjoyne together, one not deſturbing but qualifying the exceſſe of the other, as if they without eyther ſenſe or reaſon meant to teach men both: But above all,* Piety *and* Religion *enjoynes this, Are wee not all* Chriſtians, *nay are wee not all* Proteſtants *(or at leaſt ſhould be) all profeſſing one and the ſame* faith, *the ſame* Baptiſme? *have we not all one* Father, *one* Redeemer, *are wee not all* members *of one and the ſame* holy Church? *whence then are theſe diſcords amongſt* brethren, *theſe detractions amongſt* friends? *Ile ſpeake* no more, leaſt I ſeeme to teach thoſe who ſhould teach others. And this I ſpeake not with any ſolace to my ſelfe, but with greefe of heart in the behalfe of ſuch which are guilty of ſuch breakings out, and make my prayers to God for them, that they may ſee the fouleneſſe of the offence, and be incited & ſtirred up unto repentance, and make ſatisfaction for the ſame, by calling in their ſiniſter and untrue reports, And as they tender their owne reputation, ſo to bee carefull of the reputation of others, and as they love their owne peace ſo to bee ſtudious and tender of the peace of others; If they ſhall doe this there will bee ſome ſatisfaction made (though full recompenſation for Calumnie can never bee made) and comfort in their acknowledgement, and repentance. If it cannot bee by this effected, I will follow the precept of my Saviour, and pray to God for them, and walke as well as I can through good reports, and bad reports, and comfort my ſelfe with the companie of my Saviour, of the Apoſtles, and of all Gods Saints, who were not exempted from the laſh of the tongue, commending my cauſe to God (and to the equall judgement and cenſure of a Reader not partiall) to whoſe mercy likewiſe I commend them, and ſo deſiring with S^{t}. Paul that we may all keepe the unity of the Spirit in the band of peace, this ever ſhall be my wiſh

Hoc habeat concordia ſignum
Vt quos una fides, jungat & vnus Amor.

SInce my firſt publication of the uſes of my *Mathematicall Ring*, or the *Logarythmes* projected *Circular* I have beene oftentimes invited by ſundry *perſons* for to deliver the way of the *projecting*, and *dividing* of the *Circles of my Ring* upon a *Plaine*, ſo that it might bee made in *Paſtboard* to avoyde the charge of the *Inſtrument* in metal, for ſuch which have not abilities to buy, and for others, who would firſt ſee the practiſe on it, before they would be at the coſt of the *Inſtrument* in metal: for whoſe ſake, and uſe deſiring to ſatisfie the affectionat, and for a publike benefit, (rather then mine owne particular) profit, I have cauſed two *Plates* of metal to be cut and ingraved, the one containing the *Circles* of the *Projection* of my *Ring*, noted with the letter *A.* and the other comprehending the *Projection inlarged*, noted with the letter *B.* that ſo they may make uſe of them more readily, to avoid the labour of dividing the *Circles*; which *ſchemes* being paſted on a *Paſtboard* it is ready for uſe; And yet further to ſatisfie thoſe that are deſirous, I have delivered alſo in the firſt place enſuing how thoſe *Circles* are divided, that ſo they may bee made according to any *magnitude*. In the ſecond place how ſeverall wayes they may be framed into a *Ring*: In the third place I ſhew the inlarging of the *Inſtrumentall Invention* in theſe *Circles* to as great a *magnitude* for uſe as may be deſired. In the fourth place I deliver ſeverall wayes how theſe *Circles* inlarged may bee accommodated for *Practicall uſe*. In the fift place, I make a deſcription of the *Grammelogia*, or *Inſtrument* in the particular *Circles* of my *Mathematicall Ring*, projected on a mooveable and fixed plaine. And in the ſixt and laſt place, I will declare the admirable, and excellent uſes of both theſe *Inſtruments*, in the *Practicall* parts of *Arithmeticke*, *Geometrie*, *Aſtronomy*, *Horolographie*, *Navigation*. &c.